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SCIENCE

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THE HARVARD TERCENTENARY CONFERENCE OF ARTS AND SCIENCES

A DISTINGUISHED gathering of learned men will take place at Harvard University from August 31 to September 12, when seventy-five scientific men and scholars, including fourteen Nobel laureates, will meet for the Harvard Tercentenary Conference of Arts and Sciences. Announcement of the program was made on March 26 by Jerome D. Greene, director of the Tercentenary Celebration.

Daily sessions will be held for two weeks, at which leaders in the physical sciences, biological sciences, social sciences and humanities will speak. They will address themselves chiefly to the fundamental problems of science and society rather than to particular aspects of applied learning.

Since the American Mathematical Society, the Mathematical Association of America, the Institute of Mathematical Statistics and the American Astronomical Society will hold meetings in Cambridge as guests of Harvard University during the first week of September, the sections of the Tercentenary Conference which deal with mathematics, astronomy and cosmogony will be coordinated with their meetings.

Europe will be represented by forty-seven of the speakers, the United States by twenty-one, and Japan, China, Argentina, Canada and Australia, combined, by seven. The number from each country is: United States, 21; England, 12; Germany, 10; France, 6; Switzerland, 5; Italy, 4; Japan, Denmark, Scotland, Sweden and Canada, 2 each; and Holland, Argentina, Norway, Czechoslovakia, Australia, China and Austria, one each. The Harvard faculties, as hosts, will not be included among the speakers.

Nobel laureates taking part in the conference are Albert Einstein, physics, United States; Niels Bohr, physics, Denmark; Hans Fischer, chemistry, Germany; Arthur H. Compton, physics, United States;

Sir Frederick G. Hopkins, physiology and medicine, England; Robert A. Millikan, physics, United States; Friedrich Bergius, chemistry, Germany; August Krogh, physiology and medicine, Denmark; Theodor Svedberg, chemistry, Sweden; Otto Warburg, physiology and medicine, Germany; Karl Landsteiner, physiology and medicine, United States; Hans Spemann, physiology and medicine, Germany; Edgar D. Adrian, physiology and medicine, England, and Werner Heisenberg, physics, Germany.

In the symposium on the physical sciences and to some extent on the biological sciences, the sections have been determined by the subject-matter of recent research by the contributors. The third symposium, on "Factors Determining Human Behavior," enlists the collaboration of the biological sciences, the social sciences and the humanities on different aspects of a stated problem. The remaining symposia, on "Authority and the Individual" and on "Independence, Convergence and Borrowing in Institutions, Thought and Art," will likewise draw contributions from the social sciences and humanities.

A particular effort to avoid traditional and artificial barriers of specialized university study will be made during the symposium on human behavior on September 7. This part of the program will present the conclusions of eight workers in the fields of physiology, history, biochemistry, philosophy, education, anthropology and psychology.

Professor Edgar D. Adrian, University of Cambridge, will open this symposium with a discussion of the influence of the nervous system on human behavior. "Psychological Factors" will be treated by Professor Carl G. Jung, Technische Hochschule, Zurich; "Hormones," by Professor James B. Collip, McGill University; "Logic," by Professor Rudolph Carnap, Deutsche Universität, Prague, and "Culture," by Professor Bronislaw Malinowski, University of London.

At the same symposium, Dr. A. Lawrence Lowell, president-emeritus of Harvard University, will give "An Example from the Evidence of History"; Professor Pierre Janet, Collège de France, will tell of "La force et la faiblesse psychologique"; and Professor Jean Piaget, University of Geneva, will discuss "The Principal Factors Determining the Intellectual Evolution from Infancy to Adult Age."

The conference will open on August 31, with a lecture by Professor Ronald A. Fisher, University of London, before the section of mathematics of the symposium on physical sciences. This section will be in session until September 3, and will hear Professor Godfrey H. Hardy, University of Cambridge; Professor Elie J. Cartan, University of Paris; Professor Leonard E. Dickson, University of Chicago, and Professor Tullio Levi-Civita, University of Rome.

A physical science section on astronomy, on September 3, will include a paper on the "Temperature Scale of the Stars," by Professor Antonie Pannekoek, University of Amsterdam, and one on "The Composition of the Stars," by Professor Henry N. Russell, Princeton University. The following day, Sir Arthur S. Eddington, University of Cambridge, will address the section on cosmogony on "The Cosmical Constant and the Recession of Nebulae," and Professor Levi-Civita will discuss "Astronomical Consequences of the Relativistic Problem of Several Bodies."

Professors Einstein (Institute for Advanced Study), Bohr (University of Copenhagen) and Heisenberg (University of Leipzig) will conduct part of a section on theoretical physics, on September 7, relating their latest findings. Sir Arthur Eddington will also address this group on "The Constitution of the Stars."

Recent work on cosmic ray research will be reported on by Professors Millikan (California Institute of Technology) and Compton (University of Chicago), in a special section on this topic on September 8. Nuclear physics, involving the problems of isotopes and atomic transformations, will be the subject of meetings on September 8 and 9, at which fifteen investigators, whose names are yet to be announced, will present original papers.

The concluding sections of the symposium on physical science will be devoted to geology and geophysics, chemistry, industrial chemistry and communication engineering. "The Laws of Mammalian Evolution" will be treated by Dr. William B. Scott, professor emeritus, Princeton University; Professor Hans Fischer, Technische Hochschule, Munich, will report his work on "Chlorophyll"; and Professor Leopold Ruzicka, Technische Hochschule, Zurich, will speak on research on "The Male Sex Hormones."

Other speakers in these sections will include Professor Edward B. Bailey, University of Glasgow; Dr. Andrew C. Lawson, professor emeritus, University of California; Dr. Norman L. Bowen, Carnegie Institution, Washington, D. C.; Professor Peter Debye, University of Leipzig; Professor Friedrich Bergius, Deutsche Bergin-Aktiengesellschaft, Heidelberg, and Dr. Frank B. Jewett, Bell Telephone Laboratories, New York.

Recent progress of university laboratories in the study of life and disease will be described by thirteen leading scientific men in a symposium on biological sciences to be held from September 8 to 10. The sections of this symposium will deal with "The Applications of Physical Chemistry to Biology," parasitism and experimental morphology. In a special

meeting at the Harvard Medical School on September 8, various aspects of biology will be discussed.

The biological program includes a paper on "Protein Molecules," by Professor Theodor Svedberg, University of Upsala; a lecture by Professor Kiyoshi Shiga, University of Tokyo, on "The Trend of Prevention, Therapeutics, and Epidemiology of Dysentery since Discovery of its Causative Organism"; and a report by Sir Joseph Barcroft, University of Cambridge, on "The Genesis of Respiratory Movements in the Foetus." Also outlining their recent work will be Professor August Krogh, University of Copenhagen; Dr. John H. Northrop, Rockefeller Institute for Medical Research; Professor Otto Warburg, Kaiser Wilhelm-Institut für Zellphysiologie; Dr. Karl Landsteiner, Rockefeller Institute for Medical Research; Professor Ross G. Harrison, Yale University; Professor Hans Spemann, University of Freiburg; Sir Frederick Hopkins, University of Cambridge; Professor Bernardo A. Houssay, University of Buenos Aires; Professor Filippo Silvestri, Regia Scuola Superiore di Agricultura, Portici, Italy, and Professor Johan Hjort, University of Oslo.

The conference on "Authority and the Individual," on September 8 and 9, will be taken part in by sixteen authorities in economics, public finance, history, politics, philosophy, jurisprudence, international law, classical philology, sociology, literature and music. The lectures will be grouped into four sections, "The State and Economic Enterprise," "Stability and Social Change," "The Place and Functions of Authority" and "Classicism and Romanticism."

Dr. John Dewey, professor emeritus, Columbia University, will address this symposium on "Authority and Resistance to Social Change"; Professor William E. Rappard, University of Geneva, will discuss "Economic Nationalism"; Professor Corrado Gini, University of Rome, will speak on "Authority and the Individual during the Different Stages of Evolution of the Nations," and Professor Charles McL. Andrews, emeritus, Yale University, on "Conservative Factors in Early Colonial History."

Other speakers include Professor Wesley C. Mitchell, Columbia University; Dr. Dennis H. Robertson, University of Cambridge; Professor Douglas B. Copland, University of Melbourne, Australia; Professor John H. Clapham, University of Cambridge; Professor Hans Kelsen, Institut Universitaire des Hautes Etudes Internationales, Geneva; Professor Werner W. Jaeger, University of Berlin; Professor Friedrich Meinecke, University of Berlin; Professor Paul A. M. Hazard, Collège de France; Professor Howard M. Jones, University of Michigan, and Professor Edward J. Dent, University of Cambridge.

Concluding the conference, sixteen authorities in archeology, history, philology, law, divinity, literature and philosophy will deliver papers on September 10 and 11 before the symposium on "Independence, Convergence and Borrowing in Institutions, Thought and Art." Of particular interest in this symposium is a section on "East and West," with addresses on the relations of different cultures by Professor Hu Shih, National University of Peiping; Professor Masaharu Anesaki, emeritus, Imperial University of Tokyo, and Professor Paul Pelliot, Collège de France.

Cultural and institutional relations between Europe and the Near East will be the topic of another section of this final symposium. Before this group, Professor Michael I. Rostovtzeff, Yale University, will speak of "Parthian Art"; Professor Tow J. E. Andrae, University of Upsala, will lecture on "Christianity and Early Islam," and Professor Louis Ginsburg, Jewish Theological Seminary of America, will discuss "Folklore: East and West." Other speakers will be Professor Vere G. Childe, University of Edinburgh; Professor Eduard Norden, University of Berlin; Professor Leopold Wenger, University of Vienna; Professor Rene Maunier, University of Paris, and Professor Charles H. Dodd, University of Cambridge.

In a third section of this symposium, various aspects of the Middle Ages will be treated by Professor Frederick M. Powicke, University of Oxford; Dr. Henry Osborn Taylor, New York City; Professor Adolph Goldschmidt, University of Berlin; Professor Charles Bedier, Collège de France, and Professor Etienne Gilson, director of the Institute of Medieval Studies, Toronto, Canada.

A STRATIGRAPHIC VIEW OF GEOGRAPHY

By Professor EUGENE VAN CLEEF
THE OHIO STATE UNIVERSITY

SINCE the days of the brilliant Aristotle and the scholarly Eratosthenes, both of whom have been credited with having first used the term "geography," geographers have been attempting to define the scope of their field of investigation. The Greek philosophers, steeped more or less in the realm of mathematics, emphasized the descriptive aspects of geography but did not overlook that which we refer to to-day as regional. If Greek supremacy could have continued well into the first centuries A. D. and per-

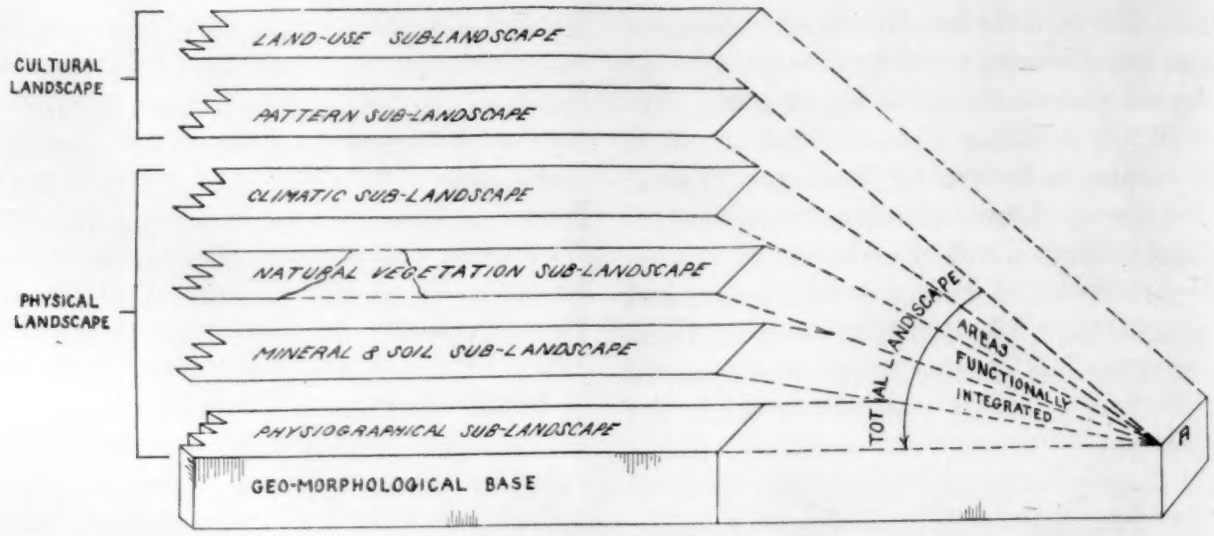

FIG. 1. A STRATIGRAPHIC VIEW OF GEOGRAPHY.

The total landscape is analyzed for its basic elements. Each element is portrayed as a plane to emphasize its areal unity. That the planes may be discontinuous is illustrated by the "natural vegetation sub-landscape" plane. Subsequent to the study of each plane, the relationship of each to any or all of the others is investigated and finally all the planes are synthesized into a single horizon known as the total landscape and resting upon the geo-morphological base. The total landscape is then considered as a unit region. (The dotted lines continuing the planes to A directs attention to the fact that the planes are component parts of a whole and in the total landscape are functionally integrated. Serrate ends of planes indicate flexible limits.)

haps until the medieval period, progress in the geographic field would undoubtedly have been greatly hastened. Even so, the influence of the Greeks was destined to pervade geographic thinking for a long time in consequence of the remarkable "Almagest" of Claudius Ptolemy and his analytical geographic writings. Ptolemy's analysis of geography has stimulated a group of our own geographers to style themselves "chorographers." This paper has been written to give consideration to that influence.

Ptolemy conceived "geography" as a description of the "öcumene" or habitable world, "chorography" as a somewhat fuller description of a region, and "topography" as a detailed description of a small locality. The description of his habitable world was mathematical. His geography was the equivalent of our present-day mathematical geography. Bunbury advances the belief that "Ptolemy devoted himself much more in the spirit of an astronomer than of a geographer in the higher sense of the word."[1] His geography focussed not only upon the earth as a planet but upon the mapping of it. There is little to indicate that he thought in terms of interpretation, even of its land forms, and yet the fact that he advanced a regional concept in his designation of chorography and topography seems to justify the belief that had Ptolemy possessed our present knowledge of the earth, he would have gladly consented to a telescoping or resolving of his three definitions into a single definition, and would have included therein two elements, namely, *description* and *interpretation*. Furthermore, since he apparently was imbued with the spirit of regionalism we venture to believe he would have insisted upon the consideration of *areas* as a third essential.

Immediately after the era of the Mediterranean philosophers there was a considerable hiatus in the development of geography as a science. Its growth was largely indirect, resulting from exploration and from the researches of men in other fields, more especially in physics, astronomy, biology and geology. The seventeenth and eighteenth centuries brought forth a considerable array of treatises in many different fields which contained both indirect and direct contributions to geography—the works of Clüver, Varenius, Montesquieu, Kant, Blumenbach, Herder and Büsching were especially valuable to their successors who specialized in geography.

Beginning with the early nineteenth century and continuing into the twentieth century geography was rejuvenated and crystallized by those master German minds of von Humboldt, von Richthofen, Ritter and Ratzel. Their contributions need not be detailed here, but it is important that we note their emphasis upon the "Raum" or regional concept. Whatever criticism may be launched against the philosophies of these men, we owe to them the organization of geography into a well-ordered science. Ritter, who was the outstanding exponent of the space relation theory, also emphasized the comparative viewpoint. It was his belief that a region should be studied so that it might be compared with other regions of the earth and that regions should be compared more especially for their

[1] E. H. Bunbury, "History of Ancient Geography," Vol. II, p. 548, 2nd edition, London, 1883.

differences than for their similarities. The study of microscopic areas was considered the proper mode of approach to the ultimate completion of a geography of the earth.

Man in relation to the physical environment, hinted at by some Greek philosophers, was revived by von Humboldt with special reference to primitive peoples, and elaborated, perhaps over-enthusiastically, by Ratzel in his "Anthropogeographie." Ratzel's environmentalism, strongly flavored by determinism, interpreted to the English-speaking world largely through Ellen Semple, exerted a powerful influence upon the researches of American geographers, still observable in many quarters. The French, too, were affected as evidenced by the writings of Vidal de la Blache, Vallaux and Brunhes, the latter two disciples of the de la Blache school. The works of these geographers contributed further to the shaping of the points of view of American writers.

A little over thirty years ago a division of geography, later to become independent, was established in the Department of Geology at the University of Chicago. J. Paul Goode, called to develop the courses in geography, fostered the "Raum" or regional concept which was strongly augmented by the Ratzelian teachings of Ellen Semple, perennial visiting lecturer. Although Goode wrote little, his influence was far-reaching through the activities of a considerable number of his students who were privileged to bask in the atmosphere of his enthusiastic leadership. Miss Semple's view-point shows its impress in much that has been written by those who listened to her detailed presentations.

Paralleling the years of growth of the department of geography at the University of Chicago and the rise of departments in other institutions, there evolved a few more or less tenuous theories relative to the science of geography, bearing particularly upon its definition and scope. Recently these ideas have focussed upon an improved technical vocabulary and upon quantitative methods in research. With these ambitions, the writer has been in full sympathy, as indicated by the titles of two papers written by him many years ago, one "The Language of Geography"[2] and the other "Leipzig—The Sum of Parallel Forces."[3]

Those who have been most energetic recently in fostering a vocabulary and a quantitative technique are members of the school of chorographers, already noted. This school not only stresses mapping and description as basic to chorography but insists that chorography is a method of approach to geography, that is, essentially a technique. At the same time, its members consider the term synonymous with regionalism. One of its proponents states: ". . . This is the chorographic technique. It differs from the others in that its immediate objective is the delimitation, description and interpretation of the areas which combined as in a mosaic make up the earth's surface."[4] Another gives the following as some of the "major tenets of the chorographer's Creed":

(1) Geography is a comparative study of the regions which comprise the earth's surface.
(2) Systematic description is an essential part of geography and must precede, and is coequal in importance with, interpretation.
(3) Man's *activities* are not of prime importance to the geographer but rather *observable material features* resulting from man's activities. Emphasis is upon a study of "things" rather than of "relationships."
(4) Features of natural environment function in a dual capacity in geography—
    a. They furnish a set of features or forms which give character to area. . . .
    b. They are only one of a number of agencies which may help to explain the forms, patterns and associations resulting from human occupance and use of the natural area.
(5) Cultural forms and patterns which are explainable in terms of natural features have no higher geographic quality than those which are explainable in terms of historical antecedents, racial characteristics or any other force or agency. There is no preference for any particular kind of explanation.[5]

Other statements[6] published subsequent to these quotations, by subscribers to the chorographic school, place similarly strong emphasis upon description as a primary and major objective in geographic presentation. These persons would probably relegate the environmental view-point to an inconsequential status. The chorographer is not interested in man's activities as such, but rather in "the observable material features" of a region, some of which may be the consequence of man's activities. Having described these observable materials he is willing to explain and interpret them, although this latter procedure seems not to be compulsory. Apparently we are to return almost wholly to the original literal meaning of the word "geogra-

[2] *Journal of Geography*, xi: 234–238, March, 1913.
[3] *Ibid.*, xii: 170–174, February, 1914.

[4] "The Objectives of Geography"—Preston James—from a mimeographed statement. Dr. James also offers in correspondence the following "broad all-inclusive statement of objectives," namely, "the description and interpretation of the face of the earth." The face of the earth includes "all the material objects which exist together in complex inter-relationship in the zone between the atmosphere and the lithosphere."

[5] "The Chorographical School of Geography"—Glen Trewartha—quoted from a mimeographed statement and from correspondence.

[6] See *Annals of the Association of American Geographers*, xxiv: 2, June, 1934.

phy," namely, earth description, which has been so roundly condemned in many quarters during these first years of the current century.

At this point we may well challenge the application of the terms chorography, chorographic and chorographer, as used by Ptolemy, to the concepts of the members of the so-called chorographic school, unless it is their wish to give these terms a modified or new connotation. If these chorographers are making literal use of Ptolemy's definition of chorography, then they must eliminate from their realm mathematical geography and its concomitant cartography to which Ptolemy paid so much attention, and also taboo microscopic studies which they have so rigorously advanced as a part of their chorographic doctrine.

It will be worth while to note what Hettner has to say about chorography, or chorology, which he uses synonymously with chorography. Few geographers are as well qualified to interpret this field. He says that chorology "is not a way," that it is not a method or technique but rather "the theme of geography itself. . . . Geographic considerations can not be other than chorological no more than historical considerations can be other than historical."[7] "The ultimate objective in the chorological viewpoint," Hettner states further, "is the recognition of the characteristics of countries and localities, growing out of the interrelationships of different natural realms and their various manifestations and the consideration of the whole earth's surface according to its natural divisions into continents, regions, natural provinces and localities.[8] And this to him constitutes the science of geography itself, which involves also the comparative and causal view-points. Thus Hettner attributes a much more inclusive meaning to Ptolemy's chorography than do our American chorographers.

In their zeal to press forward what seems to them to be a new point of view, these contemporary proponents of chorography have become enthusiasts for a methodology for use in field work which might well be clarified.[9] Granö, of Finland, has developed a methodology, probably strongly influenced by Passarge's "Landschaftskunde,"[10] to which it seems chorographers could readily subscribe and which contributes much to the elucidation of geographic objectives. Granö states that "man's environment as a material and visible complex of phenomena constitutes the fundamental objective in geographic research."[11] He believes the province of the geographer requires him to analyze the landscape and then to synthesize the analyses, for in any landscape obviously the parts are related and they must be finally viewed in their interrelationships.

In his analysis of a region, Granö recognizes a number of different landscapes constituting a unit or total landscape. He cites the landscape of land forms, of water forms, vegetation, settlement in terms of patterns, color, sounds, odors and still others. Some of these landscapes of course change with the seasons. A "sub-stratum" is included which refers to the firmness of the surface with respect to the weight which it will support, the angle of slope, earthquake disturbances and obstacles such as ice or snow. Having distinguished these landscapes and delineated them quantitatively Granö proceeds to synthesize them in such combinations as he chooses or as may be mathematically possible. On the basis of both analysis and synthesis he proceeds with interpretation. One of these landscapes or several combined may be interpreted as a natural region. While a region, according to Granö, must be characterized by homogeneity, every element within a total landscape need not be incorporated within a natural region map.

Here is an objective and a mode of approach which calls for description, mapping with precision and interpretation. It is sufficiently flexible and inclusive to allow even human ecologists and environmentalists, if they wish, to find protection under its wing. This rather lengthy preliminary statement to a much briefer proposal to follow has been presented because what I shall suggest is an attempt at clarification based upon the historical setting sketchily described.

Throughout the history of geographical thought the concept of regionalism manifests itself in one form or another, either real or implied, and with varying degrees of emphasis. To-day, we may venture to assume, geographers agree that their science is concerned with two fundamentals, namely, area and function. These elements involve three dimensions, two in the horizontal plane of area and one in a vertical plane involving the integration of function with area.

Taking a leaf from the chorographers, from Granö and from my own experience, it is my belief that in geographic analysis, area and function, respectively, should be kept intact. There should be no difficulty in doing this if geography is viewed "stratigraphically."

The term "stratigraphic" has been suggested by the field of geology, but is not borrowed with its full geological meaning. I am merely selecting certain of

[7] A. Hettner, "Die Geographie, Ihre Geschichte, Ihr Wesen und Ihre Methoden," p. 123. Ferd. Hirt, Breslau, 1927. 463 pp.

[8] *Ibid.*, p. 30.

[9] Many quantitative attempts have been predicated upon empirical premises. Some isopleth maps and fractional indices have a quantitative appearance but lack mathematical soundness.

[10] Passarge, "Grundlagen der Landschaftskunde," 1920.

[11] J. G. Granö, "Reine Geographie: Eine methodologische Studie beleuchtet mit Beispielen aus Finland und Estland," 202 pp. Helsingfors, 1929.

its geological implications for my purposes and throwing out those that do not apply. Stratigraphic suggests a series of strata or planes, as illustrated in the accompanying diagram. The strata are the equivalent of sub-landscapes which together constitute a total landscape.[12] The stratigraphic view reveals in these different sub-landscapes their important areal quality. Their succession as parts of a total landscape preserves the concept of interrelationship. Thus we recognize in our diagram (1) a physiographical plane or horizon resting upon a geo-morphological base, and (2) other horizons in accordance with the circumstance of the region under investigation.

The planes may be resolved with any or all others in the series. Some planes may be discontinuous, as illustrated by that one for natural vegetation, but all fit into their proper places when they are resolved. Furthermore, these planes, either separately or combined, may be compared with those of other distinct units or regions. This possibility satisfies the comparative philosophy in geography. The serrate edges of the planes imply that boundaries of regions are not mathematically fixed nor are the shapes of the regions necessarily symmetrical. Their extent is limited only by their homogeneity.

"A Stratigraphic View of Geography" does not imply a new kind or phase of geography, but rather is an attempt to vivify the structure of geography. Emphasis is placed upon the important phases of geography, namely, areal description, functional interpretation and comparative relationships and at the same time we keep all the science rooted in the physical earth. The stratigraphic point of view may serve as a guide or control to a systematic approach to geography, to prevent the investigator from straying along tangents and to keep before him constantly the elements which have been here listed as the objectives in geographic research.

OBITUARY

GEORGE WILLIAMSON, 1857–1936

GEORGE WILLIAMSON, professor emeritus of biology and curator of the George Williamson Museum at the Louisiana State Normal College, died at his home in Natchitoches, Louisiana, on January 10, 1936. Professor Williamson was not a research worker, but his service to science, and the natural sciences in particular, was of such outstanding value that a short sketch of his life merits the attention of his more specialized colleagues, who labor in a different manner to advance the borders of knowledge.

Mr. Williamson was born on Dunboyne Plantation, Iberville Parish, Louisiana, into an economic and social régime then on the verge of the war which was to mean its demoralization. One of his earliest memories was the news that his father, Colonel George M. Williamson, then serving under General Beauregard, had been badly wounded at the Battle of Shiloh. After the war, he removed to Guatemala, where his father was envoy. A few years later he went to Germany, by way of Cape Horn, and spent two years there. In early manhood he returned to Louisiana.

The young man's early schooling was by private tutors, and although he twice enrolled in college he never completed the course. Nevertheless, his native intelligence and scholarly habits soon distinguished him from his fellows, and in 1883 he became principal of the first state-supported high school in Louisiana, at Grand Cane. Here he began his collection of Louisiana Indian artifacts, which is to-day probably the best extant. In 1897 he was called to the Louisiana State Normal School at Natchitoches to the chair of biology, the position he filled actively until 1931, when he was made professor emeritus and curator of the George Williamson Museum, which he founded and developed, and which the college had named in his honor.

In years of service Professor Williamson was Louisiana's oldest teacher; in many respects he was her most successful one. He created and nurtured a love of nature in the minds of many at a time when the South was in the stages of recovery and men's thoughts were generally on more material things. He possessed to a marked degree the ability to create in his students of general biology such a love for and lasting interest in nature that hundreds of them, years later and in many walks of life, wrote him for information or called scientific phenomena to his attention. His museum of plant and animal fossils, minerals, Indian artifacts and historical objects was in a large measure built up by the unsolicited gifts of former students. He stimulated others to go into science, and some have made names for themselves in fields as widely separated as conchology and genetics.

Mr. Williamson's peculiar training and early experiences gave him an outlook all his own. He never lost the mannerisms and personal appearance of the Southern gentleman of another day. His lineage was of the best. He was descended from General Butler of the American Revolution, and was the great-grandson of Washington's adopted daughter, Martha Custis,

[12] Sauer recognizes but two phases of a landscape, namely site and the cultural expression.—C. O. Sauer, p. 29, University of Calif. Publications in Geography, Vol. 2, No. 2, pp. 19–53.

and his nephew, Lawrence Lewis. Characteristically, these facts meant little to him, and he so rarely mentioned them that they were known only to a few people.

This unassuming man studied for the pure love of learning and published only one paper, which concerned his discovery of fossil palm wood in the Jackson Eocene of Louisiana. He wandered at will through the fields of biology, geology and archeology. His knowledge was encyclopedic, and he has been correctly termed a true savant.

Professor Williamson won the silver medal for his Indian collection at the Louisiana Centennial in St. Louis in 1904. He was honorary curator of archeology of the Louisiana Museum of Natural History, formerly librarian of the Louisiana Academy of Sciences and a member of the Louisiana Historical Society. In 1927 he was given a testimonial of esteem by the Louisiana State Board of Education, the bestowal of such an honor being unique in the history of that body.

GORDON GUNTER

RECENT DEATHS

ROY JED COLONY, associate professor of geology at Columbia University, died on March 26 at the age of sixty-six years.

DR. TILGHAM B. MARDEN, professor of histology and embryology at the University of Maryland for twenty-seven years, died on March 18. He was sixty-six years old.

DR. MELVIN ALBERT MARTIN, professor of psychology and head of the department at Newcomb College, Tulane University, died on March 27 in his sixty-fifth year.

DR. MALCOLM LA SALLE HARRIS, formerly professor of surgery at the Chicago Polyclinic Surgical School, president of the American Medical Association in 1928–29, died on March 22. He was seventy-three years old.

THE death is announced of Professor Harry Glenn Parkinson, head of the department of agricultural education at the Pennsylvania State College, who has been serving as acting dean of the College of Agriculture and Mechanic Arts of the University of Puerto Rico, at the age of forty-six years.

MRS. FREDERICK BEDELL (Mary L. Crehore), wife of Professor Frederick Bedell, of Cornell University, herself a physicist, died on March 17.

THE death is announced of Harold Brown, for the past ten years principal of the Plant and Animal Products Department of the British Imperial Institute.

ALBERT BERZEVICZY, a former minister of Hungary and formerly president of the Hungarian Academy of Sciences, died on March 22 at the age of eighty-three years.

SCIENTIFIC EVENTS

COMMITTEE ON FORESTRY OF THE NATIONAL RESEARCH COUNCIL OF CANADA

THE National Research Council of Canada has appointed a committee to study the requirements in respect to research in all branches of forestry, including measures for the better utilization of forest products. The committee is to function as an associate committee of the National Research Council and includes in its membership representatives of the Dominion Departments of the Interior and Agriculture, in addition to the National Research Council; the forestry department of each province; members of the forestry faculties of universities in which there are departments of forestry; the lumber, pulp and paper and allied industries throughout the Dominion, the forest engineering societies, the forest protective associations and the Canadian Forestry Association.

It is understood that the committee will base its preliminary program on the findings of the Conference on Forestry Research held in Ottawa in November, 1935, at which carefully prepared papers, presented by leading authorities in the various branches of forestry throughout Canada, were fully discussed. The conference recommended the appointment of a national committee in order to provide a permanent organization representative of government, industrial, technical and educational interests concerned in the promotion of forestry in all its branches.

Surpassed only by agriculture and mining, the forests of Canada rank third among the primary industries in their contribution to national production. Among the manufacturing industries, pulp and paper production holds first place, and official statistics show that more than four thousand manufacturing plants in Canada depend on wood and paper products as their raw materials. In foreign trade, "wood, wood products and paper" stand second to agricultural products in total value and show a greater excess of exports over imports than any other group.

Represented on the committee are:

Department of the Dominion Government:

Major-General A. G. L. McNaughton, president, National Research Council, Ottawa, Ontario.

E. H. Finlayson, director of forestry, Forest Service, Department of the Interior, Ottawa, Ontario.

T. A. McElhanney, superintendent, Forest Products Laboratories, Department of the Interior, Ottawa, Ontario.

Dr. J. M. Swaine, director of research, Department of Agriculture, Ottawa, Ontario.

University Representatives:

J. M. Gibson, professor of forestry, University of New Brunswick, Fredericton, N. B.

A. Bédard, directeur, L'Ecole d'Arpentage et de Génie Forestier, Université Laval, Quebec, P. Q.

Dr. C. D. Howe, dean of the faculty of forestry, University of Toronto, Toronto, Ontario.

F. M. Knapp, professor of forestry, University of British Columbia, Vancouver, B. C.

There are in addition nine provincial and eleven industrial representatives. The joint secretaries of the committee are: D. Roy Cameron, associate director of forestry, Forest Service, Ottawa, Ontario, and S. J. Cook, division of research information, National Research Council, Ottawa.

THE FEDERAL WATER CONSERVATION PROGRAM

THE report of a special sub-committee of the Water Resources Committee of the National Resources Committee was recently transmitted to President Roosevelt.

The sub-committee, which included representatives of the chief federal agencies concerned with drainage policy and projects, was composed of the following specialists: W. B. Bell, Bureau of Biological Survey; Lt. Col. Glen E. Edgerton, Corps of Engineers; Perry Fellows, Works Progress Administration; Elmer Higgins, Bureau of Fisheries; S. H. McCrory, Bureau of Agricultural Engineering; S. A. Rohwer, Bureau of Entomology and Plant Quarantine; P. I. Taylor, Bureau of Reclamation; L. L. Williams, U. S. Public Health Service; and Abel Wolman, chairman of the Water Resources Committee, as chairman. G. F. White of the staff served as secretary.

In his letter transmitting the report to the National Resources Committee, Mr. Wolman summarized the major conclusions and recommendations as follows:

The Sub-Committee finds that (1) conflicts of Federal activity in drainage work, resulting in unnecessary waste and delay, have occurred; (2) the number of such conflicts may be expected to increase as a result of recent extensions of Federal authority over drainage work, and (3) all but a few of the conflicts might have been prevented had there been opportunity for reconciliation of policies during the planning of the various programs. It recommends, therefore, an administrative mechanism for promoting balanced consideration of proposed Federal projects, and for reducing friction and delay in their execution. The same findings and recommendations apply to projects for impounding water.

The recommended mechanism requires (1) authority for the National Resources Committee to serve as a clearing house of information and opinion concerning proposed Federal drainage and water-storage programs, and (2) provision by the National Resources Committee of personnel to staff the suggested Sub-Committee which would review programs. In short, the Sub-Committee has found a clear-cut deficiency in national water planning, and has proposed a simple, inexpensive method intended to remedy it.

The Water Resources Committee endorses the report unanimously, and urges that the Advisory Committee approve the report and take prompt action to effectuate the recommendations.

On receiving the report, which included a comprehensive discussion of the problem, President Roosevelt issued the following memorandum designed to prevent duplication, delay and conflict in drainage and water storage projects and to eliminate dubious proposals at their inception:

From investigations made by the National Resources Committee, it appears that unnecessary waste and delay in the execution of land drainage and water storage projects result from the failure of Federal agencies to secure review of projects from all relevant points of view while the work is being planned, and that certain projects which are ill-advised from public health, wild life conservation, or other standpoints, may be undertaken because such review is not made.

Please instruct appropriate officials of your agency to submit a statement of impending programs involving land drainage or water storage to the National Resources Committee at regular intervals in order that other agencies having an interest in the work may be informed by the committee of the programs well in advance of their initiation.

APPOINTMENT OF DR. JAMES T. JARDINE AS DIRECTOR OF RESEARCH OF THE U. S. DEPARTMENT OF AGRICULTURE

DR. JAMES T. JARDINE has been appointed director of research for the U. S. Department of Agriculture. Dr. Jardine has served as chief of the Office of Experiment Stations since 1931 and will continue in this capacity. His additional assignment becomes effective immediately.

As chief of the Office of Experiment Stations and director of research, Dr. Jardine will be responsible for three major activities. He will continue in charge of the Office of Experiment Stations, which administers Federal grants to the states and territories for agricultural experiment stations, and coordinates this work with similar research of the department. As director of research, he will cooperate with the bureaus in planning and coordinating their research work. As

a third function, he will have general administration of a Special Research Fund made available by the Bankhead-Jones Act, approved June 29, 1935, including the planning and coordination of the research program of the department under this fund.

Dr. Jardine has recently served on several important committees in developing plans for research. He is chairman of a committee for soil conservation research and is serving on the land policy committee, the committee on plant and animal improvement and many others.

Dr. Jardine, a native of Idaho, was born on November 28, 1881. His early life was spent on a farm. He was graduated from the Utah Agricultural College in 1905, after which he did special work at the University of Chicago. He then returned to the Utah Agricultural College as instructor in English.

In 1907 he became a special agent for the Forest Service. He was forest supervisor from 1908 to 1910 and inspector of grazing, in charge of the National Forest Range Investigations and Range Surveys from 1910 to 1920, when he became director of the Oregon Agricultural Experiment Station. He remained in this position until coming to the Department of Agriculture in 1931.

Dr. Jardine has made various investigations for the government, among these being a study of the agricultural situation in Alaska and a survey of the Land Grant Colleges and Universities. He compiled the report of the findings of research in this latter survey. This gave him an unusual opportunity to familiarize himself with the work of the experiment stations throughout the country.

He is a fellow of the American Association for the Advancement of Science, member of the Washington (D. C.) Academy of Sciences, member of Sigma Xi, Phi Kappa Phi and of several other honorary societies. The Kansas State Agricultural College conferred on him the degree of D.Sc. in June, 1935.

Dr. Albert F. Woods was director of scientific work from 1926 to June 30, 1933, when the office was discontinued.

AWARDS OF THE MEDALS OF THE FRANKLIN INSTITUTE

THE Franklin Institute of the State of Pennsylvania announces that the Franklin Medal this year will be awarded to Dr. Frank Baldwin Jewett, vice-president, American Telephone and Telegraph Company and president and director of the Bell Telephone Laboratories, and to Dr. Charles Franklin Kettering, vice-president and director of the General Motors Corporation and general director of the General Motors Research Laboratories, Detroit.

The Franklin Medal is awarded annually from the Franklin Medal Fund, founded January 1, 1914, by Samuel Insull, Esq., "to those workers in physical science or technology, without regard to country, whose efforts, in the opinion of the institute, acting through its committee on science and the arts, have done most to advance a knowledge of physical science or its applications."

The presentation of the gold medal and certificate will be made at 3:30 P. M. on the afternoon of Wednesday, May 20, in the hall of The Franklin Institute, Philadelphia, at formal exercises presided over by Nathan Hayward, president of the institute. Former recipients of the medal include:

1930: Sir William Henry Bragg, Royal Institution of Great Britain, and Dr. John P. Stevens, Baltimore, Maryland.

1931: Sir James H. Jeans, astronomer, and Dr. Willis R. Whitney, of the General Electric Company.

1932: Professor Philipp Lenard, Heidelberg, and Dr. Ambrose Swasey, Cleveland.

1933: Dr. Paul Sabatier, University of Toulouse, and Dr. Orville Wright, Dayton, Ohio.

1934: Professor Henry Norris Russell, of Princeton University, and Dr. Irving Langmuir, of the General Electric Company.

1935: Dr. Albert Einstein, Princeton, N. J., and Sir John Ambrose Fleming, England.

Dr. Jewett will receive the medal "in recognition of his many important contributions to the art of telephony, which have made conversation possible not only from coast to coast, but from this country to the other side of the world—contributions of which some were made by him alone, and some by him in collaboration with other workers in the great laboratory of research which he organized and which he has directed with such signal success."

Dr. Kettering will receive the medal "in recognition of his significant and timely contributions to the science of automotive engineering—a science out of which has grown the greatest industry in this country, the manufactured product of which has, in only a quarter of a century, changed the face of the civilized world."

A correspondent writes:

In 1904, Dr. Jewett joined the staff of the American Telephone and Telegraph Company in the engineering department, and three years later was placed in charge of its electrical department. He entered the telephone field at a time when that industry was on the threshold of a great expansion and the value of scientific research was just beginning to be appreciated. He brought to the telephone industry a mind thoroughly trained in scientific procedure and a contagious enthusiasm for surmounting difficulties.

From 1908 until the entrance of the United States i

the World War, Dr. Jewett continued his services with the American Telephone and Telegraph Company, and also worked for the Bell Telephone Company, and the Western Electric Company. During his association with the latter company, many of the most important advancements in the fields of communications were made. These included the development of the vacuum tube, improvements in the art of inductive loading, building of the transcontinental telephone lines, development of the telephone repeater, introduction of machine switching on a large scale by the Bell System, and the development of high speed submarine telegraph cable. As an engineer, Dr. Jewett had a large share in all of these developments, and as an executive he helped to weld diversified units of the Bell System into a well balanced and efficient whole.

In regard to Dr. Kettering:

After graduation Mr. Kettering spent seven years with the National Cash Register Company. He then became associated with the Dayton Engineering Laboratories Company, which was manufacturing one of his inventions, the Delco starting, lighting and ignition system for automobiles, which is now used all over the world. In 1916 Mr. Kettering established his own laboratory at Dayton, Ohio. In 1920 this was taken over by the General Motors Corporation and combined in 1925 with other research operations in Detroit. This group of engineers and scientists now function under his supervision.

Mr. Kettering's genius and ability enabled him to contribute in many ways to the electrical, mechanical and aeronautical divisions of service during the war. He has been the recipient of many honors from various colleges and universities, and has always been foremost in encouraging scientific and educational societies and groups.

SCIENTIFIC NOTES AND NEWS

Dr. Thomas Parran, Jr., was nominated on March 23 by President Roosevelt as Surgeon General of the Public Health Service, to succeed Dr. Hugh S. Cumming, who retired on February 1. Dr. Parran has been since 1917 an Assistant Surgeon General of the Public Health Service, from which post he has been on leave since early in 1930 to enable him to fill the position of New York State Commissioner of Health.

The medal of the American Institute of Chemists, presented annually for distinguished service to the science of chemistry or the profession of chemist in America, has been awarded this year to Dr. Marston Taylor Bogert, professor of organic chemistry at Columbia University. The award is made in recognition of Dr. Bogert's "outstanding service as a teacher and as an investigator in the field of organic chemistry." Last year the award went to Dr. James Bryant Conant, president of Harvard University. Past medalists include Andrew W. Mellon and Richard B. Mellon, honored for establishing the Mellon Institute for Industrial Research; the late George Eastman, who made fine organic chemicals available to the chemists of the country; Mr. and Mrs. Francis P. Garvan, who established the Chemical Foundation; Dr. H. C. Sherman, for his food researches, and Dr. Charles H. Herty, paper chemist. The medal will be presented to Dr. Bogert at the annual dinner of the institute to be held in Buffalo on May 9.

In connection with the opening on March 31 of a series of scientific lectures given under the auspices of the Eldridge Reeves Johnson Foundation for Research in Medical Physics at the University of Pennsylvania, honorary degrees were conferred on Dr. Joseph Erlanger, professor of physiology at Washington University, St. Louis, and Dr. Herbert Spencer Gasser, director of the laboratories of the Rockefeller Institute for Medical Research.

The senatus of the University of Edinburgh has voted to confer the doctorate of laws on Dr. Edward L. Thorndike, director of the Institute of Educational Research of Teachers College, Columbia University.

Dr. Ross G. Harrison, Sterling professor of biology at Yale University, has been elected a corresponding member of the Bavarian Academy of Sciences.

Captain Lucius W. Johnson, of the Navy Medical Corps, and Dr. Edward R. Baldwin, of Saranac Lake, N. Y., will receive the 1936 awards of the Kober Foundation of Georgetown University. Captain Johnson, plastic surgeon, was the choice of the executive committee of the Association of Military Surgeons, as the Kober lecturer for the year. Dr. Baldwin was selected by the Association of American Physicians as the Kober medalist. He is director of the Trudeau Foundation at Saranac Lake.

The Loder Rhododendron Cup for the year 1936 has been conferred by the Royal Horticultural Society of London on Alfred Rehder, associate professor of dendrology at Harvard University and curator of the Herbarium of the Arnold Arboretum.

A bill has been passed in the Senate to authorize award of the Distinguished Flying Cross to Lincoln Ellsworth for his recent 2,500-mile flight across an unexplored part of the Antarctic.

Dr. Rudolph Matas, emeritus professor of surgery at Tulane University, was the guest of honor on March 19 at the annual dinner of the New Orleans Chapter of the American Red Cross.

At the recent meeting of the Alabama Academy of

Sciences, presided over by Dr. Walter B. Jones, state geologist, Dr. Roger Allen, of Auburn, was elected president. Professor J. R. Cudworth, director of the State Bureau of Mines Experiment Station at the university, was named vice-president in charge of the section on geology, anthropology and archeology, and Dr. Septima Smith was reelected secretary. The academy grant for research, given annually by the American Association for the Advancement of Science, was presented to Dr. Septima Smith.

Nature reports that at the annual general meeting of the Geological Society of London, the following officers were elected for 1936–37: *President,* Professor O. T. Jones; *Vice-presidents,* J. F. N. Green, Professor H. L. Hawkins, Professor W. J. Pugh, Professor H. H. Swinnerton; *Secretaries,* Professor W. T. Gordon, Dr. L. Hawkes; *Foreign Secretary,* Sir Arthur Smith Woodward; *Treasurer,* F. N. Ashcroft.

PROFESSOR WESLEY B. HALL, of the department of electrical engineering of Yale University, has resigned to become head of the department of electrical engineering at the Rhode Island State College. He succeeds the late William A. Anderson, whose death occurred last December.

APPROVAL by the Board of Education of Detroit of the appointment of Dr. Raymond B. Allen, associate dean of the Columbia University Medical School and associate director of the New York Post-Graduate Medical School and Hospital, to the position of dean of the College of Medicine of Wayne University, Detroit, Mich., has been announced by Dr. Frank Cody, president of the university and superintendent of schools.

DR. ERIC OLDBERG, acting head of the department of surgery at the College of Medicine of the University of Illinois, has been appointed professor and head of the new department of neurology and neurological surgery.

THE University of Rochester has announced the appointment of Frederick L. Hovde, assistant professor of chemistry at the University of Minnesota, a former athlete and Rhodes scholar, to organize and direct its new scholarship program. Under the plan the university will establish 120 scholarships with maximum yearly grants of $500 for exceptional students from all over the country.

DR. F. H. BAKER, Lowndean professor of astronomy and geometry at the University of Cambridge, who will retire at the end of the academic year, will be succeeded by W. V. D. Hodge, lecturer in mathematics and fellow of Pembroke College.

FRED D. BUTCHER, entomologist and plant disease specialist of the North Dakota Agricultural College Extension Service, has been appointed associate entomologist in the Bureau of Entomology of the U. S. Department of Agriculture, where he will specialize on grasshopper control work.

DR. ERNST SCHAFFNIT, editor of *Pflanzen Krankheiten,* who recently retired as director of the Institute of Plant Industry at Bonn, will spend a year at University Farm, University of Minnesota, as an honorary fellow, giving lectures and carrying on research work in plant physiology and plant pathology.

THE Board of Trustees of the Rockefeller Institute for Medical Research announces the election of Dr. Walter Bradford Cannon and Dr. George Hoyt Whipple as members of the Board of Scientific Directors.

DR. A. C. SEWARD, professor of botany and master of Downing College, University of Cambridge, has been appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

DR. ALDO CASTELLANI, of the Royal Italian Medical Corps, member of the faculty of the School of Medicine of the Louisiana State University, will not give his annual lectures at the Medical School this spring. Dr. Castellani is commander-in-chief of the Italian Medical Corps and must remain close to the Ethiopian situation until the war is ended.

DR. ENRICO FERMI, professor of theoretical physics at the University of Rome, member of the Royal Academy of Italy, will be a member of the faculty of the summer school of Columbia University. He will direct work in the department of physics on nuclear phenomena, natural and artificial radioactivity and the transmutation of nuclei.

DR. ROBERT T. HATT, director of the Cranbrook Institute of Science, Bloomfield Hills, Mich., and Mrs. Hatt have returned from a survey of physical and educational equipment in fifty-two museums of England, Holland, Germany and France, preparatory to the planning of exhibits and laboratories for the projected building of the Cranbrook Institute of Science.

DR. OTIS W. CALDWELL, general secretary of the American Association for the Advancement of Science, delivered the principal address on the evening of March 20 at the eighty-third annual meeting at Tulane University of the New Orleans Academy of Science. Dr. Caldwell spoke on "Popular Notions and Modern Science."

PROFESSOR EMERITUS DANIEL WEBSTER HERING, curator of the James Arthur collection of clocks and watches, who has been for fifty years a member of the faculty of New York University, delivered the fifth

annual James Arthur Lecture on "Time and Its Mysteries" on April 2. The title of his lecture was "The Time Concept and Time Sense Among Cultured and Uncultured Peoples." Previous lecturers have been Dr. Robert Andrews Millikan, Dr. John Campbell Merriam, Professor Harlow Shapley and the late Dr. James Henry Breasted.

DR. GEORGE W. CORNER, professor of anatomy in the School of Medicine and Dentistry of the University of Rochester, has been appointed Thomas Vicary lecturer for 1936 of the Royal College of Surgeons of England. The lecture, which will deal with a subject in the history of anatomy or surgery, will be given in December next. In connection with his proposed visit to London Dr. Corner will also deliver by invitation a series of four lectures under the auspices of the University of London and of Guy's Hospital Medical School on the physiology of the ovarian hormones.

DR. CHARLES C. COLBY, professor of geography at the University of Chicago, recently gave a lecture on "Science in Regional Planning" before the Senior Research Group of the Tennessee Valley Authority, not six lectures as previously reported.

FREE public lectures on "The Relation of Science to Human Welfare" will be given from April 7 to 10 by the Institute of Public Affairs of the Vanderbilt Student Union. The following lectures are announced on the preliminary program: "The Changing Picture of the Universe," by Professor Frederick Slocum, Wesleyan University; "The Responsibilities and Limitations of Science toward Human Affairs," by President J. C. Merriam, the Carnegie Institution of Washington; "Economic Effects of Paper Manufacture from the Southern Pine," by Dr. Charles H. Herty, director of the Savannah Pulp and Paper Laboratory, and "Science and Common Sense in Modern Physics," by Dr. W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute. Following the lecture on April 7 there will be demonstrations of the research, facilities and equipment in the Vanderbilt Medical School, and following the lecture on April 9 there will be demonstrations in the Vanderbilt Engineering School and in certain other scientific departments of the university.

THE twelfth scientific session of the American Heart Association will be held on May 12 from 9:30 A. M. to 5:30 P. M., at Hotel Phillips, Kansas City, Mo. The program will be devoted to cardiac insufficiency.

THE first meeting of the psychologists of the State of Oregon was held at the University of Oregon, on February 28 and 29, under the chairmanship of Professor Howard R. Taylor. Two sessions were held, one devoted to the teaching of elementary psychology, the other to a discussion of research projects. On Friday evening after an informal dinner, Dr. Gesell's sound film "Life Begins" was presented. Professor William Griffith, of Reed College, was designated chairman for the meeting to be held next year at Reed College. Dr. Calvin S. Hall, of the University of Oregon, was elected secretary.

ARRANGEMENTS have been completed for the meeting of the American Pharmaceutical Association and affiliated organizations in Dallas, Texas, during the week of August 24 to 29. At this time, the Texas Centennial Exposition will be in full operation. Walter D. Adams will serve as local secretary for the meeting and Sam P. Harben as chairman of the committee on arrangements.

THE fifteenth International Congress of Medical Hydrology, Climatology and Geology will be held at Belgrade in October. Further information can be obtained from Professor Milontine Neskovitch, 3 rue Takowska, Belgrade.

THE second International Congress of the Scientific and Social Campaign against Cancer will be held in Brussels from September 20 to 26. The congress is under the patronage of the King of the Belgians and of Queen Elizabeth. The program has been divided into two main groups, embracing the scientific campaign and the social campaign against cancer. Further particulars may be obtained from M. W. Schraenen, general secretary to the congress, 13, Rue de la Presse, Brussels, Belgium.

THE formation of a section of microchemistry, with Professor A. A. Benedetti-Pichler, of Washington Square College, New York University, as chairman, is announced by the American Chemical Society. In adding the new group to its network of professional units, the society, according to the announcement, "accords official recognition to a young branch of science which is influencing practically every field of chemistry and biology." These units, through which organized chemistry in America functions, now number nineteen, and enroll nearly 20,000 chemists representing every major sphere of chemical science. The microchemical section, initiated chiefly through the efforts of New York members, will bring into association several hundred research workers from all parts of the country. It will convene for the first time at the ninety-first meeting of the society in Kansas City, Mo., to be held from April 13 to 17.

THREE special committees, appointed by Dr. S. C. Lind, director of the School of Chemistry of the University of Minnesota, who was recently elected director of the new Institute of Technology at the university,

have begun a study of methods of combining entrance requirements in its three branches to go into effect next autumn. The Institute of Technology is composed of the College of Engineering and Architecture, the School of Chemistry and the School of Mines and Metallurgy. M. Cannon Sneed, chief of the division of inorganic chemistry, is chairman of the committee on registration, entrance requirements and curriculum for first-year students. Other members of the committee are Professor Elting H. Comstock, of the mines faculty; Robert W. French and I. W. Geiger, associate professors of drawing and chemistry, respectively, and Charles A. Koepke, associate professor of mechanical engineering. Professor Geiger; W. E. Brooke, head of the department of mathematics and mechanics; Howard D. Myers, associate professor of engineering; Professor W. T. Ryan, electrical engineering, and Professor Comstock will study entrance requirements. Chairman of the group studying a common curriculum for all first-year students in the institute is Professor W. H. Kirchner, head of the department of drawing and descriptive geometry. Others are Professor Comstock; Henry C. Eggers, assistant professor of drawing; F. M. Mann, head of the School of Architecture, R. E. Montonna, associate professor of of chemical engineering; Professor John R. DuPriest, head of the department of mechanical engineering, and Dean Ora M. Leland, of the College of Engineering and Architecture.

Nature states that two British expeditions to observe the total eclipse of the sun on June 19 are leaving for sites selected from which to observe the eclipse. The path of the total eclipse stretches from Greece over Siberia to the Pacific Ocean. An expedition led by Professor F. J. M. Stratton, of the Solar Physics Observatory, Cambridge, will station itself in northern Japan. The program of eclipse observations consists chiefly of observations of intensities of lines in the flash spectrum; despite the vigorous growth of the technique of spectrophotometry in the last decade, very few spectrophotometric observations have been made on eclipses, chiefly on account of the ill-luck through cloud which has attended recent expeditions. The second British expedition will be led by Professor J. A. Carroll, of the University of Aberdeen, and will proceed to a site in the U.S.S.R. where the eclipse will take place near midday.

DISCUSSION

OBSERVATIONS ON THE CULTIVATION OF POLIOMYELITIS VIRUS

IT is stated generally and is to some extent accepted as a fact that filterable viruses can not be cultivated on ordinary lifeless media. While many of these ultramicroscopic forms have been observed to multiply in vitro in the presence of living susceptible cells or in modified tissue culture media, these successes seem to build all the more solidly on the postulate that the viruses are probably obligate parasites. The characteristics, distinguishing peculiarities and the techniques required for the demonstration and study of viruses and their behavior have been described fully by Rivers[1] and collaborators in this country and by Bedson[2] and associates in England. On the basis of their findings one is compelled to accept as a dictum—no virus multiplication without the presence of viable or susceptible cells or tissue in a culture medium.

Of particular interest in this connection are the reports of a few investigators who brought forth evidence which was at variance with the definition of a virus, notably regarding its requirements for actual multiplication outside the animal body. Eagles and McClean,[3] working with vaccine virus, claimed to have cultivated the virus in a "cell-free" medium containing extract of rabbit kidney tissue, serum and Tyrode's solution. Rivers and Ward[4] were unable to confirm these results and succeeded shortly afterward in establishing the correctness of the observations of Maitland[5] and coworkers, who had previously shown that it was possible to accomplish this only in the presence of minced kidney tissue. It followed from subsequent studies by Rivers[6] that splenic and testicular tissue could also supply the necessary elements for growth of vaccine virus. Eberson,[7] in an attempt to cultivate the virus of poliomyelitis in a medium containing

[1] T. M. Rivers, The Harvey Lectures, 1933–34, Baltimore, Williams and Wilkins Company; *Pennsylvania Med. Jour.*, April, 1933; *Am. Jour. Med. Sci.*, 190: 435, 1935; Rivers' Filterable Viruses, 1928, Baltimore, Williams and Wilkins Company; *Jour. Exp. Med.*, 52–60, 1930–35.

[2] S. P. Bedson, *Brit. Jour. Exp. Path.*, 8: 470, 1927; 11: 502, 1930; 13: 65, 1932; 14: 267, 1933; 15: 243, 1934; *Newcastle Med. Jour.*, 15: 55, 105, 1935; *The Lancet*, 1277, December 7, 1935.

[3] G. H. Eagles and D. McClean, *Brit. Jour. Exp. Path.*, 11: 337, 1930; 12: 97, 1931; see also G. H. Eagles and A. H. H. Kordi, *Proc. Roy. Soc. London*, Series B, 111: 329, 1932.

[4] T. M. Rivers and S. M. Ward, *Jour. Exp. Med.*, 57: 51, 1933.

[5] H. B. Maitland and M. C. Maitland, *Lancet*, 2: 596, 1928; *Brit. Jour. Exp. Path.*, 11: 119, 1930; 13: 90, 1932.

[6] T. M. Rivers and S. M. Ward, *Jour. Exp. Med.*, 57: 741, 1933.

[7] F. Eberson, *Proc. Soc. Exp. Biol. and Med.*, 29: 477, 1932; SCIENCE, 75: 519, 1932; *Proc. Soc. Exp. Biol. and Med.*, 30: 92, 1932; *Jour. Lab. and Clin. Med.*, 18: 565, 1933; *Jour. Immunol.*, 24: 433, 1933.

macerated sheep brain, successfully transmitted the disease in serial passages through *Macacus rhesus* monkeys by means of cultures of the virus in dilutions ranging from 2×10^{-7} to 2×10^{-27} of the original material.

In view of what has been discussed it is now apparent that the asserted lifeless culture medium of Eberson can not be regarded as such. The observations and conclusions drawn from that study are explainable only on the basis of a modified tissue culture which was capable of supporting the existence of poliomyelitis virus and enabling it to multiply in the presence of viable and susceptible cells. Hence the results which embodied transmissibility in series, infectivity and immunological considerations were not surprising or unexpected. A reexamination of the original protocols and a scrutiny of the photomicrographs which illustrated the article indicate clearly that the visible bodies or "organisms" multiplied in and about the tissue particles, the nuclear elements especially. This was stated unequivocally in the text with regard not only to the subculturing of the material in serial dilutions, but also with reference to the type of inoculum employed in the transmission of the disease to monkeys. An experiment performed in 1931 at the Rockefeller Institute,[8] with a submitted culture in the eighth subplant representing a dilution of the original inoculum of approximately 2×10^{-17}, emphasized this point. There it was decided to inject intracerebrally in a monkey one cubic centimeter of the supernatant fluid from lightly centrifuged *culture material which had previously been ground in a mortar with sterile quartz sand.* The infective power of such a culture was successfully demonstrated when poliomyelitis developed after one week in the test animal, from which in turn it was possible to transmit the infection to another monkey with material derived from a suspension of brain and nervous tissue. The intimate relation of the multiplying virus to the tissue particles of the culture medium was thus indubitably shown.

With regard to the brain tissue medium itself it was stated that it must have been lifeless in consequence of the mode of sterilization. This assumption, despite subsequent thermal controls, was erroneous. Adequate heat penetration was made difficult, owing to the nature of the medium and its containers during the process of sterilization. That there was considerable variation in the different lots of medium as a result of this would follow from the irregular successes of some infectivity experiments, particularly in the later subplants from cultures beyond the tenth generation. Supplementary experiments designed to cultivate the virus with thoroughly cooked culture medium prepared in another laboratory resulted in failure. This was to be expected from the nature of the virus and thus confirmed the fact that the substrate used originally could not have been lifeless in the accepted sense.

Regardless of present or future attempts to cultivate certain viruses in lifeless media, and assuming this as only remotely possible, much knowledge concerning their behavior and properties can be gained nevertheless by a study of viruses in a tissue culture medium or some modification of it. This has been amply demonstrated recently for the infective agents of vesicular stomatitis,[9] poliomyelitis,[10] psittacosis[11] and louping ill,[12] all these having yielded to cultivation in media similar to that used for vaccine virus.

In discussing this subject it is recognized that the difficulty in cultivating a virus is related directly to its degree of parasitism. Subject to this condition it should be possible to devise methods of study with culture media adapted to the needs of individual viruses. Considering their widely divergent behavior in the animal and human tissues, is it not paradoxical to suppose that all viruses in common should conform to a single type of cell-host parasitism?

A study is now in progress to determine whether or not the virus of poliomyelitis can be adapted to cultivation in various modifications of culture media containing suitable tissue and physiological fluids. It should be of some interest to ascertain the possible relationship between the ability of a given virus to multiply and its reputed degree of parasitism, to the end that a "parasitic index" for viruses in general might be evaluated.

FREDERICK EBERSON

101 GROVE ST.,
SAN FRANCISCO, CALIF.

[8] F. Eberson, *Jour. Lab. and Clin. Med.*, 18: 586, 1933.

[9] H. R. Cox, J. T. Syverton and P. K. Olitsky, *Proc. Soc. Exp. Biol. and Med.*, 30: 896, 1933.

[10] E. Gildemeister, *Cent. Bakt.*, Abt., 1, Ref., 109: 284, 1933.

[11] S. P. Bedson and J. O. W. Bland, *Brit. Jour. Exp. Path.*, 15: 246, 1934; J. O. W. Bland and R. G. Canti, *Jour. Path. and Bact.*, 40: 231, 1935.

[12] T. M. Rivers and S. M. Ward, *Proc. Soc. Exp. Biol. and Med.*, 30: 1300, 1933.

THE VITAMIN C CONTENT OF APPLES AND ITS RELATION TO HUMAN WELFARE

IN view of the extreme variety differences in vitamin C content of apples[1,2,3,4] it has been pointed out[5] that the exchange of certain varieties of apples

[1] M. F. Bracewell, E. Hoyle and S. S. Zilva, *Biochem. Jour.*, 24: 82–90, 1930.

[2] M. F. Bracewell, E. Hoyle and S. S. Zilva, *British Med. Res. Council, Sp. Rpt. Ser. B.*, 146: 3–145, 1930.

[3] C. R. Fellers, P. D. Isham and G. G. Smith, *Proc. Am. Soc. Hort. Sci.*, 29: 93–97, 1932.

[4] G. G. Smith and C. R. Fellers, *Proc. Am. Soc. Hort. Sci.*, 31: 89–95, 1934.

[5] W. Franklin Dove, *Am. Nat.*, 69: 469–544, p. 524, 1935.

for other varieties would deprive 200,000 to 440,000 people (depending upon production rates) in one particular apple section (Maine) of their yearly vitamin C supply.

This fact becomes increasingly important because of attempts which have been made in recent years to bring about cooperative production (and distribution) whereby apple growers in delimited areas of the country have been encouraged to combine in their efforts and concentrate upon the production of single varieties. That the correct variety of fruit be selected for cooperative production is manifestly important to the welfare of the consuming public. In some regions the choice of varieties unfortunately has been made in favor of a low-vitamin apple.[6] There is a trend toward low vitamin C apples in various parts of the country. At the present time there are more trees of the Delicious variety than of any other variety in the United States.[7] The Delicious is one of the varieties poorest in vitamin C.

The cooperative-production plan may be economically sound, but if put forth without due regard to vitamin selection will certainly prove to be biologically unsound—especially in regions where citrus fruits are not grown and are therefore expensive, and since food habits and cooking methods can only slowly be readjusted to harmonize with the most recent information secured from vitamin research and health surveys. Other nutritional factors being equal, varieties of fruits and vegetables adapted to the particular geographical environment and high in vitamin content would be desirable.[8] In regions adapted to apple production, the apple could be depended upon as the principal source of antiscorbutic vitamin, a source of special value because the apple is generally consumed raw.

However, attempts to take advantage of vitamin research in the apple industry bring out some difficulties which tend to discourage the consideration of vitamins in fruit-breeding programs. Some agriculturists feel that the apple breeder must follow the preference of the consuming public and that if the public desires a certain variety, that variety it must have, regardless of low vitamin content. It might, of course, be pointed out that the results of extensive experiments[5] demonstrate the fact that proximity can divert the nutritive desires of the individual. But an answer more likely to be accepted by those loath to educate the consumer is that vitamin potency should be bred into varieties that are already acceptable to the consuming public.

[6] *Maine Ext. Bul.*, 214: 1–19, 1934.

[7] C. C. Thompson, *Wash. State Agr. Exp. Sta. Bul.*, 277: 1–108, 1933.

[8] W. Franklin Dove, *Maine Agr. Exp. Sta. Bul.*, 375: 191–284, p. 268, 1934.

However, at this point a second difficulty arises. It is claimed that the generation process in the fruit tree takes too long a time to permit of positive vitamin work. It is true of course that the time will be no longer, perhaps, than the time required to alter the food demands of the population. Still, however, the difficulty is a real one. Could an experimental method be found whereby the generation interval might be reduced from the present requirement of 12 to 15 years to one of a year or less, many advantages would ensue.

It has occurred to the writers that should the characteristic vitamin C content of the fruit be a characteristic also of the sap, leaf, stem or root tissues or of other non-fruit parts of the tree, a part of the seedling could be tested as an indicator of the future vitamin potentiality of the fruit. The gain in time might make vitamin research a feasibility in apple-breeding plans.

In the present communication the results of preliminary tests made on the ascorbic acid content of leaves of two varieties of apples—one high in vitamin C (Northern Spy) and one low in vitamin C (McIntosh) are here presented. The titrimetric method, using the dye indicator, 2, 6-dichlorophenol indophenol, in the technique as modified by Bessey and King,[9] was followed with a change from the hot acetic acid to cold acetic acid for stabilization of the vitamin. The determinations of the ascorbic acid content of the leaves were made in September and October during and after apple harvest time.[10] On 17 different days the leaves were tested from these two varieties, the Northern Spy and the McIntosh. In 14 of the 17 tests the ascorbic acid content of the Spy leaves exceeded that of the McIntosh leaves. The mean difference in ascorbic acid content between the two varieties was $0.246 \pm .0682$ mg. of vitamin C per gm of fresh leaves. The odds were 68.4:1 that the differences were significant. The results of 15 tests made after the adaptation of the technique to the material gave an average ascorbic acid content of .7457 mg per gm for the McIntosh and 1.1203 mg per gm for the Northern Spy. Thus the vitamin C content of the leaves bears a direct relation to the vitamin C content of the fruit. The Northern Spy apple is from five to six times as potent in vitamin C as is the McIntosh apple (4 to 6.5 grams of Northern Spy apple equals 20 to 25 grams of McIntosh apple[3,4,11]).

[9] O. A. Bessey and C. G. King, *Jour. Biol. Chem.*, 103: 687–698, 1933.

[10] The writers are indebted to both Mr. R. M. Bailey, of the Experiment Station, and Professor J. H. Waring, of the horticultural department of the University of Maine, for plant materials used in these tests.

[11] E. L. Batchelder, *Jour. Nutr.*, 7: 647–655, 1934.

Further tests are in progress in order to determine the earliest age at which these differences in ascorbic acid content of the leaves or other non-fruit parts of the plant are detectable. If the method proves successful and adaptable to other fruits and vegetables, it will make possible a "vitamin sieve" to precede all other tests of adaptability, winter hardiness, consumer preference and trade demands.

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DETERMINATION OF THE CHLOROPLAST PIGMENTS OF PLANTS

THERE is considerable evidence at hand on the possible relationship of the chloroplast pigments, especially the carotinoids, to sexual reproduction in plants.[1] To minimize discouragement in this type of study[2] and the drawing of premature conclusions one should exercise particular care in methods of determination of the carotinoids, a significant percentage of which may be lost in the process of extraction and purification. Of even greater importance is the selection of proper material for the quantitative analysis of these pigments. Carotene, for instance, seems to increase in concentration (Murneek—soybean leaves) and in quantity (Virtanen *et al.*—peas and wheat) till the time of flowering and early fruit setting and then decreases rapidly. Hence the mere determination of these pigments in "fruiting" and "vegetative" plants loses significance, unless their developmental states are carefully correlated with the analytical assay. In fact, at certain stages of growth the fruiting plants may have less carotene than the non-fruiting ones.

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VERTEBRATE LOCALITIES IN SOUTH PARK, COLORADO

DURING the past three summers we have been cooperatively engaged in a geological study of South Park, Colorado. This project was financed at first by grants from Northwestern University and from anonymous contributors, and brought to a successful conclusion, thanks to a grant from the Geological Society of America. With the permission of the society, the following brief account is published as of interest to stratigraphers and especially to vertebrate paleontologists.

The basin of South Park has been the site of subaerial and fresh-water deposition at various times since the Laramide Revolution. There are four localities where we have found fragmentary but identifiable vertebrate remains. Since, for lack of time, only short periods (a day or less in any one place) were devoted to search, there is reason to believe that any of these localities may yield better remains when more carefully examined.

Three of these localities appear to represent beds of White River age and are in what we have tentatively designated the Antero beds. In the southwest quarter, section 33, T. 12 S., R. 76 W., tuffaceous beds above a conglomerate bore fragments of a tooth identified by Mr. C. W. Gilmore, of the National Museum, as that of a titanothere or possibly uintathere of Oligocene or late Eocene age. In the southwest quarter, section 8, T. 14 S., R. 75 W., is a cut exposing fine tuff and gritty, blocky clays, mostly white to light gray in color, which aggregate about 120 feet in thickness; from these beds teeth, skull bones and limb bones were collected, representing six mammalian forms and pronounced by Mr. C. L. Gazin, of the National Museum, to be of White River (Oligocene) age. About a mile east of the Fairplay-Antero Junction highway in section 22, T. 10 S., R. 77 W., on the east side of a flat-topped ridge, white tuff beds are capped by pinkish sandy clays with local conglomeratic layers. From the pink beds several small fragmentary jaws and teeth were collected, representing chiefly insectivores, marsupials and artiodactyls, and referred by Mr. Gazin to White River age.

Immediately south of the park, on the divide separating South Park from Wagon Tongue Creek, in sections 31 and 32, T. 14 S., R. 75 W., gravelly and clayey beds, having a thickness of about 250 feet and tentatively called by us the Wagontongue beds, are well exposed in two northward-facing cuts. From the eastern exposure one jaw representing an Equid was collected and on this basis Mr. Gazin referred the beds to the upper Miocene or Pliocene.

The collections from these localities have so far been given tentative study only, but faunal lists are available. Our project does not include further collecting in the near future. We publish this note in the hope that others may find it possible to devote more time to search for fossils in the places listed. All except the last are readily accessible by secondary roads. If

[1] S. Satina and A. F. Blakeslee, *Proc. Nat. Acad. Sci.*, 12: 191–196 and 197–202, 1926. R. Chodat and W. H. Schopfer, *Comptes Rendus Soc. Phys. et Hist. Nat.*, 44: 176–179, 1927. M. Cajlahjan, *Comptes Rendus Acad. Sci. U. S. S. R.*, 1: 1:40–42, 1932. A. T. Virtanen *et al.*, *Biochem. Zeitschr.*, 267– 1–3: 179–191, 1933. A. E. Murneek, SCIENCE, 79: 528, 1934.

[2] SCIENCE, 82: 596, 1935.

further particulars are wanted the undersigned will be glad to supply them.

J. T. STARK
J. HARLAN JOHNSON
C. H. BEHRE, JR.
W. E. POWERS
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OCCURRENCE OF THE MALONE AND TORCER FAUNAS AT THE BASE OF THE ARIZONA COMANCHEAN

THE stratigraphic problems associated with the interpretation of the Upper Jurassic–Lower Cretaceous sequence of the Malone district in Texas are well known. Briefly summarized, in 1905 Cragin described as the "Malone formation" strata near Malone, Texas, that contain ammonites and lamellibranchs.[1] He interpreted the entire assemblage of the Malone fossils as belonging to the Upper Jurassic. The Jurassic (Kimmeridgian) age of the Malone ammonites, collected by Cragin, was upheld by V. Uhlig and later by L. F. Spath. In 1926 F. L. Kitchin demonstrated that the *Trigoniae* described by Cragin could not be of earlier age than Valanginian (earliest Cretaceous) and emphasized that there was no proof that all of Cragin's fossils came from a single horizon.[2]

W. S. Adkins, therefore, restricted the term Malone to the Jurassic part of the section of central Malone Mountain near Torcer station on the Southern Pacific Railway west of Sierra Blanca, and introduced the name Torcer for the Cretaceous (Neocomian) portion of Cragin's "Malone formation."[3]

In the lower part of the Cretaceous sequence near Bisbee, Arizona, there are limestone beds that contain abundantly represented and well preserved specimens of *Trigonia vyschetzkii* Cragin, *Trigonia calderoni* (Castillo and Aguilera), *Trigonia goodelli* Cragin, *Trigonia proscabra* Cragin, *Pleuromya inconstans* Castillo and Aguilera, *Astarte* (*Eriphyla*) *malonensis* Cragin, *Exogyra potosina* Castillo and Aguilera and other lamellibranchs described by Cragin from the Malone area. The conditions of deposition apparently were the same as at Malone, and forms referred by Cragin to *Astrocoenia* and *Serpula* are found in abundance. Immediately above these limestone beds are cross-bedded sandstones and fresh-water-laid sandstones with large silicified tree logs. In the younger argillaceous limestones *Dufrenoya texana* Burckhardt, marking the Upper Aptian (Travis Peak), is found.

About 500 feet below the Trigonia beds are grits alternating with sandstones and impure limestones. The grits yield *Idoceras schucherti* (Cragin) which demonstrates the Kimmeridgian (early Upper Jurassic) age of these strata.

A detailed account of this find will be published in the near future.

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SCIENTIFIC BOOKS

ANATOMY OF VERTEBRATES

The Microscopic Anatomy of Vertebrates. By G. G. SCOTT and J. I. KENDALL. 306 pp., 167 figs. Lea and Febiger, Philadelphia, 1935.

THIS is an elementary treatise on vertebrate histology that is designed to fit a college course one semester in length. For this reason the descriptions have been kept brief and relatively simple, although by judicious elimination of minor detail and justifiably dogmatic presentation a surprisingly large amount of information is made accessible. The style is clear and readable and the arrangement of text-matter logical. There is an adequate index.

The illustrations, mostly original, are partly unlabelled photomicrographs and partly line drawings. The former are rather good in comparison to the natural limitations of this ideally desirable but practically disappointing medium. The line drawings make no pretense toward the faithful portrayal of cell, tissue or organ structure but exist as diagrams which serve in a stylized way as keys to what might be found in actual preparations. No magnifications are given, since the authors believe college students incapable of comprehending such magnitudes. To the reviewer this seems a definite shortcoming and a palpable libel on collegiate intelligence. But even admitting that a college student can not visualize what is implied in an illustration being enlarged 10, 100 or 1,000 times the original size, it still is true that such information allows one to judge of relative size by knowing that certain drawings were made in the ratio of 200 to 400 units, and so on. Nevertheless, the authors state that the student constantly using the microscope will have little difficulty in appraising the degree of magnification and that he can measure things mentally by the familiar artifice of using the erythrocyte as a yardstick. One wonders, however, if escape has not been made from one difficulty into worse ones. The degree of magnification, as judged by the eye, is something like stating the apparent size of the moon, while the correct sensing of the absolute value of the micron is probably harder than understanding magnification values. Moreover, in a comparative course the verte-

[1] F. W. Cragin, "Paleontology of the Malone Jurassic Formation of Texas," U. S. Geol. Survey Bull. 266, 1905.

[2] F. L. Kitchin, "So-called Malone Jurassic Formation in Texas," *Geological Magazine*, Vol. 63, pp. 454–469, 1926.

[3] W. S. Adkins, "The Mesozoic Systems in Texas," University of Texas Bull. 3232, pp. 286–291, 1932.

brate erythrocyte proves to be a unit of variable size, the largest thirty or more times the diameter of the smallest. In rebuttal the authors might perhaps argue that this is the best of training in preparation for an economic and social order in which one must pass trippingly from one sliding-scale standard to another!

Like the illustrations which are selected from various vertebrates, the descriptions are to a considerable extent comparative as well. It is anticipated by the authors that certain of the descriptions given will not fit accurately the specific laboratory material used in a comparative course, but this is held to be advantageous inasmuch as it emphasizes variability. There is a certain magnificence in such authorial nonchalance which, thus disclaiming further responsibilities, places the comparative foundling so neatly on the doorstep of colleagues whom they set out to aid. But practically the outcome could scarcely be otherwise, and for college students the drawing of study material from comparative sources has too much in its favor to be discarded for the single-type approach. An excellent feature is the inclusion of a brief bibliography at the end of each chapter to call attention to representative original papers in the more accessible journals (mostly American) and to serve as starting points for more extended collateral reading. With but few exceptions these reference articles are in English—a matter of sound practical judgment since American college students are singularly incapable of making effective scientific use of the foreign languages over which they have labored so long in the classroom. A final chapter gives instruction in the fundamentals of histological technique.

This book should prove a useful and reliable aid to those teachers of general college courses who find it impractical to make use of a more ambitious text. If the average college student actually finished his semester in microscopic anatomy with a fair fraction of the contents of this book verified and digested, then his instructor would have ample reason for jubilation.

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Northwestern University Medical School

ZOOLOGY

Three books published during the year 1935 have been received for review. These include a condensed outline of biology, a new and original general textbook of biology and a laboratory manual.

An Outline of General Biology. By Gordon Alexander. vii + 181 pp.; Barnes & Noble, New York, $0.75.

This little outline reminds one of Selenka's Taschenbuch. It begins with a well-executed "quick reference table to standard text-books," which should be useful to students and teachers. There are four divisions in the body of the work: (1) life in its simplest forms, (2) multicellular organisms, (3) general principles and (4) human relations of biology. Two appendices are devoted to a rather unprogressive classification of plants and animals and a brief, carefully considered but at times inaccurate glossary. On the whole the outline is succinct, thoughtful, interesting, accurate, sensible and well written.

An Introduction to Biology. By Edward Loranus Rice. xii + 602 pp. Ginn and Company, Boston. $3.20.

This book, by a man who has for a generation been respected by zoologists as a successful teacher, is an excellent introduction. It has been written for the use of college students with the idea that "an elementary course in biology can not give a very extensive knowledge of fact; it can and should give an insight into the significance of biology and an appreciation of its spirit." The first three chapters discuss biology, protoplasm, cells, osmosis and other fundamental matters; seven chapters are devoted to man—life functions, alimentation, respiration, excretion, circulation, reproduction, motion, nervous functions and chemical coordination; eight chapters deal with the frog; and the remaining chapters are devoted to classification, earthworm, hydra, amoeba, unicellular plants, higher plants, comparison of plants and animals, food and oxygen cycles, evolution, heredity, variation, evidences and methods of evolution and human evolution. Three appendices include a table of equivalent weights and measures, a bibliography and etymologies for scientific terms. The book is the work of one who understands biology and loves students. It is original, thoughtful and well done.

Laboratory Guide in Animal Biology. By Robert H. Wolcott and Eugene F. Powell. vii + 101 pp. McGraw-Hill, New York. $1.00.

This is designed to accompany Wolcott's "Animal Biology." It is an unprogressive example of "type-study" ideals. Type animals from amoeba to frogs are described in order; with interpolated exercises on the microscope, maturation and embryology and mytosis. Detailed directions are given as to how students are to observe, dissect and draw. To the reviewer the guide seems to be rather poorly written. Such terms as "forms," "ones" and "highly developed" are often used loosely. As an example of careless thought the irrelevant questions under "Thigmotropic Responses" on page 31 may be cited. Perhaps a student in a scientific laboratory should have a chance at times to

perform a task according to his own judgment. He might then have his work graded and criticized on the basis of whether he had done a good or a bad piece of work or whether his ideals of scientific procedure were right or wrong. It appears that a student who used the present manual would get a high grade if he did "what teacher said."

A. S. PEARSE

REPORTS

AWARDS OF THE ELLA SACHS PLOTZ FOUNDATION

DURING the twelfth year of the Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation, seventy applications for grants were received by the trustees, thirty-four of which came from the United States, the other thirty-six from fifteen different countries in Europe, Asia and South and North America. The total number of grants made during this year was twenty-five, one of these being a continued annual grant. Twelve of the new grants were made to scientific men outside of the United States.

In the twelve years of its existence, the foundation has made two hundred and fifty-two grants, which have been distributed to investigators working in Argentina, Austria, Belgium, Canada, Chile, China, Czechoslovakia, Esthonia, France, Germany, Great Britain, Hungary, Italy, Jugoslavia, Latvia, Netherlands, Palestine, Poland, Portugal, Roumania, South Africa, Sweden, Switzerland, Syria, Venezuela and the United States.

The list of investigators and the purpose of their researches aided in the current year is as follows:

Professor E. Aubel, Paris, the synthetic reactions of the liver and their rôle in specific dynamic action.

Professor Dr. G. Barkan, Tartu-Dorpat, Esthonia, the biology of iron and iron metabolism.

Professor Marston Taylor Bogert, Columbia University, New York, New York, synthesis from *p*-xylene.

Dr. S. J. Crowe, the Johns Hopkins Hospital, physiology of the ear.

Dr. William Dameshek, Boston, blood pigment metabolism in lead poisoning.

Professor Dr. Philipp Ellinger, London, the kidney and vitamin B deficiency.

Professor Erdheim, Vienna, a special joint disease of dogs.

Professor E. Gelhorn, University of Illinois College of Medicine, Chicago, the influence of hormones and vitamins on phagocytosis.

Dr. W. Gohs, Vienna, the etiology of blood diseases and osteodystrophy fibrosa.

Dr. Arthur Grollman, the Johns Hopkins University, the adrenals; crystallization of the hormone.

Dr. F. Gudernatsch, New York University, growth.

Dr. I. F. Huddleson, Michigan State College, Brucella infection.

Dr. H. A. Krebs, Cambridge, England, the mechanism of ketogenesis and anti-ketogenesis.

Dr. Jean LaBarre, Brussels, extraction of incretine from duodenal extract.

Dr. Hans Lampl, Vienna, mechanical heat regulation in animals.

Professor O. Loewi, Graz, anterior lobe of pituitary and carbohydrate metabolism.

Dr. Charles C. Lund, Boston, the hormone intermedin.

Dr. Michel Magat, Paris, France, the hydration of ions.

Dr. John R. Murlin, University of Rochester, New York, the mechanism of secretion.

Dr. Yellapragada SubbaRow, Harvard Medical School, Boston, isolation of materials.

Thorndike Memorial Laboratory, Boston City Hospital, (Professor George R. Minot, director), continued since 1927 in recognition of Dr. Francis W. Peabody's services to the foundation.

Professor Dr. Ernst Wertheimer, Jerusalem, the relationship between free and bound glycogen in normal and pathological conditions.

Dr. Carl J. Wiggers, Western Reserve University, the dynamics of the coronary circulation.

Dr. William F. Windle, Northwestern University Medical School, the development of behavior in the embryo.

Professor Dr. Fritz Verzar, Basel, physiological research by Dr. Laszt.

The maximum size of the grants will usually be less than $500. Applications for grants to be held during the year 1936–1937 must be in the hands of the executive committee before May 1, 1936. They should be sent to Dr. Joseph C. Aub, Collis P. Huntington Memorial Hospital, 695 Huntington Avenue, Boston, Massachusetts, U. S. A.

SPECIAL ARTICLES

THE ABILITY OF RATS TO DISCRIMINATE BETWEEN DIETS OF VARYING DEGREES OF TOXICITY[1]

IT is a rather common belief that animals possess the ability to select foods most beneficial to them when a choice is offered. In an area where the forage possesses varying degrees of toxicity this ability would have tremendous significance. In certain districts in the great plains area, seleniferous vegetation probably occurs as an interspersion of vegetation of varying

[1] Published with the permission of the director of the South Dakota Agricultural Experiment Station as communication No. 21 from the Department of Experiment Station Chemistry, and is Part XIII of "A New Toxicant Occurring Naturally in Certain Samples of Plant Foodstuffs."

degrees of toxicity. Steyn[2] found that specimens of the same plant in the same stage of development and growing beside each other varied considerably in toxicity. Many of the residents of these districts are firm in the belief that range animals are able to recognize the seleniferous vegetation and eat only the least toxic or normal forage. If this belief is based on fact, then one solution to the problem would be the reversion of the land to a grazing area. The experiment reported below lends support to the idea that animals recognize seleniferous vegetation.

Franke[3] observed that rats on a toxic diet invariably restricted their food intake, and Franke and Potter[4] showed that this food restriction was mainly responsible for the poor growth of the experimental animals. Osborne and Mendel[5] and Mitchell and Mendel[6] reported experiments which indicated that rats possess the ability to select the proper constituents for normal growth, although Kon[7] reported an experiment in which rats which selected their own quantities of protein, carbohydrate and salt showed growth which was inferior to that of rats on a compounded diet. Forbes and Bechdel[8] reported that young deer did not like laurel and rhododendron, which are toxic, and if allowed grain would eat very little of these plants.

The experimental work reported herein was much easier to control than any of the experiments reported above, and demonstrates conclusively that rats possess the ability to recognize diets of varying selenium content.

EXPERIMENTAL

A preliminary experiment (Series 59) was carried out in which a group of five rats were given two diets, each compounded according to the same formula diet No. 3 (see reference note 4), but one made with normal wheat and the other made with toxic wheat No. 582, which contains 30 ppm of selenium by analysis. In four 30-day periods the intake of toxic diet, in terms of per cent. of the total, was 6.3 per cent., 3.2 per cent., 4.1 per cent., and 2.7 per cent., respectively. On the basis of this observation, a second experiment (Series 113) was set up in which several diets of varying toxicity were offered.

Ten rats of Wistar Institute origin were weaned at twenty-one days of age and placed on the control wheat diet (No. 3). When the age of the rats was thirty-seven days, they were divided into two equal groups and placed in two all-metal stock cages with raised screen bottoms. Group I was given a choice of four diets, which were mixtures of the control wheat diet and the toxic wheat diet, so that the rats were given a choice between (1) control diet, (2) 25 per cent. toxic diet plus 75 per cent. control diet, (3) 50 per cent. toxic diet plus 50 per cent. control diet, and (4) 100 per cent. toxic diet. Group II was given control wheat diets to which had been added various amounts of sodium selenite. A total of five diets were offered as follows: (1) control, (2) 7.5 ppm of selenium, (3) 15 ppm of selenium, (4) 30 ppm of selenium, and (5) 60 ppm of selenium. Inasmuch as wheat No. 582 contains 30 ppm of selenium, the diets for Group I contained 0, 6.15, 12.3 and 24.6 ppm of selenium, respectively, and contained no diet comparable to the 60 ppm selenium diet in group II.

The diets were placed in identical spill-proof feed cups, placed at random in the cages. The various diets were made up to a total of twenty-five grams each, on the supposition that the five rats would normally eat about fifty grams of feed and would accordingly eat all the least toxic diet and be forced to the

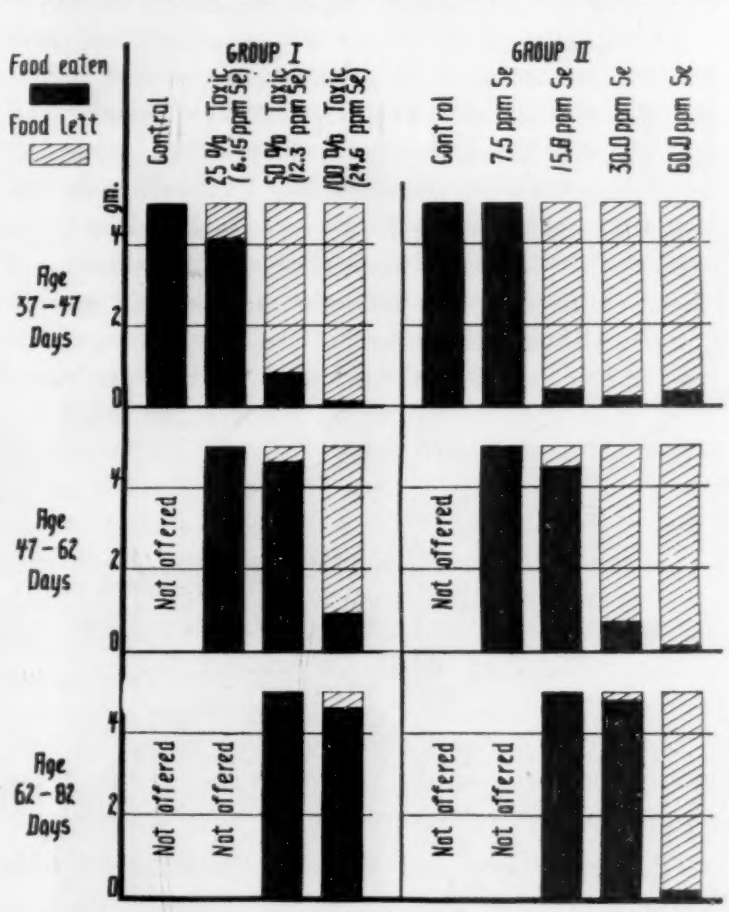

FIG. 1. Food intake in grams per rat per day for rats on natural and artificial selenized diets, where the least toxic foodstuff is limited in order to allow the animals to show whether or not they can differentiate between the various degrees of toxicities.

[2] D. G. Steyn, 18th Rept. Dir. Vet. Serv. and Animal Industry, Union of S. Africa, 899–938, 1932.
[3] Kurt W. Franke, *Jour. Nutrition*, 8: 597, 1934.
[4] Kurt W. Franke and Van R. Potter, *Jour. Nutrition*, 8: 615, 1934.
[5] T. B. Osborne and L. B. Mendel, *Jour. Biol. Chem.*, 35: 19–27, 1918.
[6] H. S. Mitchell and L. B. Mendel, *Am. Jour. Physiol.*, 58: 211, 1921.
[7] S. K. Kon, *Biochem. Jour.*, 25: 473–481, 1931.
[8] E. B. Forbes and S. I. Bechdel, *Ecology*, 12: 323–333, 1931.

next toxic diet to appease their hunger. Food intake was recorded daily. After ten days, the control diets were no longer offered in either group, and after fifteen days, the next least toxic diet was no longer offered. In every instance, the rats ate the least toxic food that was available and ate negligible quantities of the more toxic diets. The average food intake in grams per rat per day is indicated in Fig. 1. Since the diets were of identical compositon, the only variable in group I was the amount of toxic grain, and in group II, the only variable was the amount of sodium selenite. It is apparent that the rats were able to distinguish between diets which differed in selenium content by small increments. The animals were also able to distinguish between various concentrations of the natural toxicant, in spite of the fact that in this case the selenium is in organic combination (Painter and Franke[9]). Although constituents other than selenium may have furnished a clue to toxicity in the naturally toxic diets, there was certainly no other possibility in the diets used in group II.

No deaths occurred in the above experiment, although growth was subnormal. When killed, the animals showed typical pathologic effects for sub-lethal diets.

Conclusions

It has been quantitatively demonstrated that rats are able to detect and differentiate between small quantities of selenium in foodstuffs. Unpublished data in this laboratory have shown that sub-lethal injections of sodium selenite cause a voluntary starvation even when normal diets were offered. The question whether or not systemic effects may be the entire factor controlling this differentiation should not be ignored, although this selection of foods may be due to taste of the diets or even odor.

Kurt W. Franke
South Dakota State College

Van R. Potter,
Wisconsin Alumni Research Foundation Fellow, Madison

SUBMERGED VALLEYS ON CONTINENTAL SLOPES AND CHANGES OF SEA LEVEL

Between 1893 and 1902 Spencer,[1] Hull,[2] Upham[3] and others advanced the hypothesis that certain topographic features discovered on the continental slopes of Europe, North America and Africa were submerged river valleys. Their ideas met with much hostile, though somewhat unfounded, criticism from their contemporaries[4] and, being thus discredited, were practically forgotten for thirty years. The work of Shepard in the last few years has reopened the whole problem and again brought it to attention. The development of sonic sounding has made possible detailed investigation of the topography of the sea bottom. The U. S. Coast and Geodetic Survey is at present producing charts with very accurately located bathymetric contours which leave no doubt as to the bottom configuration and presence of the valleys.

It now appears extremely likely that Spencer, Hull and Upham were correct in their conclusion that the valleys are submerged river valleys. The validity of this conclusion will not be discussed as it has already been treated more or less fully in the several papers by Shepard[5] and also by Hess.[6] Professor R. A. Daly has recently advanced the hypothesis that the valleys are the result of submarine scour by muddy salt water produced by the 250 ± foot lowering of sea level during the Pleistocene. Though this hypothesis is well worthy of consideration, the form of the valleys, the fact that they have been deeply cut in some cases through rocks as resistant as granite, and finally that any slight turbulence would cause a mixing of the muddy water with the surrounding water, all lead the writers to favor a subaerial origin. In this note the writers wish briefly to advance a hypothesis accounting for the valleys and point out some of the chief geologic consequences which this hypothesis, if correct, would entail. Explanatory hypotheses have been elsewhere advanced, but none of them fit the facts as now known.

Distribution and Depths

At least forty of these submerged valleys have been noted, and no doubt many more will be found when more soundings are taken on the continental slopes. They are known to occur in many parts of the world; off the coast of North America from Newfoundland south; off the coast of Europe from Ireland south; off Ecuador and Peru on the west coast of South America; off the coast of North America from Vancouver Island south; on the west side of the Pacific off Japan, Formosa and the East Indies; on the east coast of Africa off the Congo, Niger, Cape Verde and Gibraltar Straits; in the Indian Ocean off Ceylon; off the Indus and the Ganges and in the Arabian Gulf; and south of Zanzibar on the east coast of Africa.

Many of the valleys are known to extend to depths

[9] E. Page Painter and Kurt W. Franke, *Jour. Biol. Chem.*, 111: 643, 1935.

[1] J. W. Spencer, *Bull. Geol. Soc. Amer.*, 14: 207–226, 1903.

[2] E. Hull, "The Sub-Oceanic Physiography of the North Atlantic Ocean," London, 1912. Also, *Royal Geog. Jour.*, 13: 285–289, 1899. Also, Victoria Inst., 1898–1908.

[3] W. Upham, *Am. Geol.*, 10: 222–223, 1892.

[4] *Royal Geog. Jour.*, 13: 289–294, 1899.

[5] F. P. Shepard, *Geog. Review*, 23: 77–89, 1933. *Trans. Am. Geophys. Union*, 1933 and 1935.

[6] H. H. Hess, *Trans. Am. Geophys. Union*, 168–170, 1933.

of thousands of feet, but very little information is available as to the maximum depths to which the valleys extend. The valley which may be the seaward extension of the Potomac River, recently surveyed by the U. S. Coast and Geodetic Survey, appears to reach 8,800 feet below sea level (latitude 37°). Several valleys in the Bahamas, investigated by reconnaissance only during the gravity measuring cruise of the U. S. submarine S–48, apparently reach 14,000 feet (latitude 26°). The English Channel valley, on the other hand, probably does not go down to a thousand fathoms (latitude 49°).

Topographic and Geologic Age

The valleys, as far as known, are extremely youthful topographically, thereby indicating a geologically short episode of subaerial erosion.

The data presented by Stetson suggest a younger than Pliocene age for the valleys, while Veatch has evidence that the Congo submarine canyon is post-Mousterian; and Shepard, from several lines of evidence, postulates a Pleistocene age. The suggestion of a pre-Miocene age, originally advanced by Hess, in view of the new data, should now be discarded, though the possibility of valleys of more than one age should be kept in mind.

Deductions

The world-wide distribution and similarity of the valleys indicate a change in relative sea level rather than independent vertical movements of each of the continents. This change must have taken place suddenly; then, after a short interval, sea level must have returned practically to its original level, since it is known that the sea level along the east coast of North America has been near its present level for most of Cretaceous, Tertiary and Pleistocene time, as indicated by sediments of those ages on the Coastal Plain.

Shepard[7] has recently suggested as a working hypothesis that this change of sea level may have been accomplished by locking up water from the seas in ice caps over the Poles. Though this would account for a lowering of sea level and its later return to its original level, it has, we consider, insuperable quantitative difficulties, since the ice would have to have been something like 50,000 feet thick.

Hypothesis

It is proposed that the valley-cutting conditions resulted from a sudden change in the shape of the hydrosphere, depressing sea level in low latitudes, raising it in high latitudes; in other words, a change in the ellipticity of the sea surface.

[7] F. P. Shepard, Talk before the Section of Oceanography, Am. Geophys. Union, April, 1935.

At present we can think of no orthodox cause for this change of ellipticity of sea level. However, a speculation comes to mind; if a sudden decrease in the rate of rotation of the earth took place, the hydrosphere would respond by being drawn into polar latitudes. The solid body of the earth would less rapidly adjust itself into a new spheroid in equilibrium with the slower rotation, which adjustment, when complete, probably would restore sea level to approximately its present position. But during the adjustment, it is postulated that there would have been time enough to allow rivers to cut valleys on the continental slopes. While of course we do not know what could have caused the sudden change in rotation, it is conceivable that a collision with a small extra-terrestrial body would be competent to produce the effect. The grave difficulty of changing the earth's rate of rotation is readily admitted. The authors would welcome any suggestions of other means by which the ellipticity of sea level might be changed.

If the sequence of events thus outlined actually occurred, two major effects should be found: (1) the maximum depths of the valleys should decrease poleward from an equatorial belt, and (2) beyond a particular latitude above and below the equator no valleys should be found, but instead marine phenomena, shore lines, terraces, etc., should occur above present sea level if not completely destroyed by subsequent erosion. The terraces and shore lines should be found at progressively higher altitudes poleward from this same latitude. Evidence of a colder climate flora and fauna might be found in equatorial regions which would have become high plateaus if sea level had been depressed there as much as our hypothesis necessitates.

The few available facts are compatible with the hypothesis here suggested. First, none of the valleys yet found lie above latitude 55° or 60°. The very meager data available do suggest an increase in depths of the valleys from 55° toward the lower latitudes. Marine terraces in latitudes greater than 55° or 60° have not been recognized so far as the writers are aware. It may be noted that the lack of valleys in polar regions and deepening of the valleys progressively toward an equatorial belt, *if true,* is a fatal obstacle to Daly's hypothesis.

We submitted the idea of slowing down the earth's rotation to Professor H. N. Russell for criticism. He points out that it is extremely difficult to change the rate of rotation of an isolated astronomical body, particularly to the extent which this hypothesis would demand. He suggests omitting the hypothesis of change of rotation from this note, and merely suggesting the change in ellipticity of sea level. We feel, however, that it can do no harm and might bring forth some discussion of other possibilities.

GEOLOGIC CONSEQUENCES

If changes in sea level such as herein suggested have taken place, an explanation is available for possible migration of flora and fauna in equatorial belts without the necessity of drifting continents or uplifting land bridges. Such alterations of sea level and ocean masses would also cause large changes in climates with resulting influence on life. It is, also, not beyond the realm of possibility that the internal changes necessitated during the adjustment of the solid earth might produce stresses which would result in orogenesis.

We have hesitated to present this hypothesis for some time because of its radical and highly speculative nature; but we have decided to advance it, though with much doubt in our own minds as to its validity, in order to invite criticism which might ultimately give rise to a satisfactory explanation. Also, we hope that discussion may focus attention on evidence of submergence in high latitudes and new data on submerged valleys.

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DECEMBER 31, 1935

SCIENTIFIC APPARATUS AND LABORATORY METHODS

MEASUREMENT OF THE AREA OF ATTACHED AND DETACHED LEAVES

IN various types of investigations it is often desirable to measure regular or irregular areas quickly and accurately. Especially is this true for attached or detached leaves of plants which differ in size, color and thickness. To facilitate such work a suitable apparatus has been devised. In principle the method consists in the use of a light source capable of producing a small amount of radiant flux, part of which passes through a condensing lens, two plates of glass, a second condensing lens and a diffusion screen, and finally onto a photoelectric cell attached to a meter by means of which a reading is taken. When it is desired to secure the area of any given objects, they are placed between the plates of glass, thus intercepting a portion of light and reducing the amount of radiant energy striking the photoelectric cell. The decrease in the electromotive force generated by the light-sensitive cell is proportional to the light intercepted by the objects, and the reduction indicated by means of a meter.

The various parts of the measuring device were fastened to a metal frame, Fig. 1 F. As a light source a twenty-one candle power automobile lamp was mounted by means of adjustable clamps to the metal frame, A. One condensing lens, twelve inches in diameter, was mounted in a metal ring and attached to the frame at a distance below the light approximately equal to the focal length of the lens, and another lens of the same size was attached at a lower position, B. Below the lower lens at a distance slightly less than its focal length a Weston Photronic cell, E, was attached to the frame with an adjustable clamp. A piece of acid etched glass, slightly larger in area than the photoelectric cell, was fastened about one inch above the cell and served as a diffusion screen, D. Finally, removable clamps supporting two pieces of window glass were fastened between the two lenses, C. The entire frame was then suspended by means

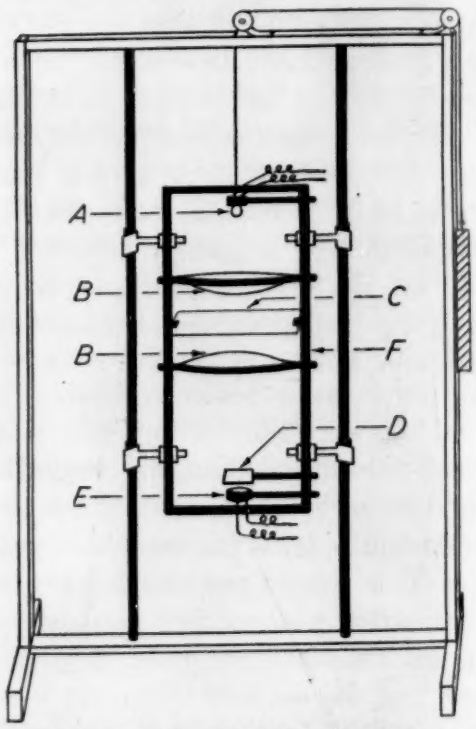

FIG. 1. Diagram of apparatus used to measure attached and detached leaves. A indicates a light source, B lenses, C glass plates, D diffusion screen, E photoelectric cell and F a metal frame.

of a cable between two vertical metal pipes in a larger wooden frame. It was therefore easily possible to adjust it to any level at which it was desired to secure a measurement.

In actual use, the distance between the upper and lower lenses was sufficient to allow for easy manipulation of the glass plates between which the leaves or other objects were placed in order to keep them flat and hold them in position. The distance between the photoelectric cell and the lower lens was finally adjusted so that the diameter of the light beam from the lenses was slightly less than the diameter of the light-sensitive surface of the cell. The lamp was energized by means of a six-volt storage battery. The photoelectric cell was connected to a microammeter, having an internal resistance of 63.5 ohms, and a sliding resi

tance of 44 ohms was shunted across the meter terminals to control the energy output of the photoelectric cell.

After placing the apparatus in a dimly illuminated room and protecting the cell from direct bright light, the shunt resistance was adjusted to give full deflection of the microammeter needle. Several adjustments were usually necessary during the following 15 to 20 minutes, while the electrical system reached equilibrium, but no difficulty was encountered thereafter. Calibration was effected by successively placing circular pieces of cardboard of various known sizes between the glass plates and in the path of the light beam, C, and noting the consequent reduction in the energy output of the photoelectric cell for each piece as indicated by the microammeter. The resultant calibration curve drawn from these observations is a straight line.

The area of a large leaf or a large number of small leaves which occupied most of the area covered by the light beam was determined when the two glass plates were held between the two lenses, C. The area of small leaves or a small number of them having an aggregate area of less than 45 cm² could be determined with accuracy only when the glass plates were held below the lower lens. In this position, even small leaves intercepted a large percentage of the concentrated light energy, and their areas were determined from a second calibration curve made with the glass plates in this position.

It is evident from the work of Withrow,[1] Gerdel and Saulter,[2] and others, that the amount of light energy intercepted from a beam of light by a leaf depends not only upon the size of the leaf but also upon its power to transmit and reflect light. They have also demonstrated that the amount of light transmitted or reflected varies with different types of leaves. In measuring leaves that vary in color and thickness by the methods described by these authors, it is necessary to correct the readings for errors caused by variations in the amount of light transmitted and reflected by different types of leaves.

By using the apparatus described above, however, providing the intensity of the light striking the surface of the leaf was less than about 15-foot candles, as measured by a Weston light meter, the radiant energy transmitted and reflected by leaves was not sufficient to cause significant errors in area measurements. Tests showed that identical areas cut from cardboard or leaves of different colors and thickness gave area readings which varied about 1 per cent. from the mean (Table 1). No appreciable error in area measurements resulted from the amount of light reflected from the surface of pieces of cardboard of different colors. When the light intensity at the leaf surface was greater than about 15-foot candles unreliable results were obtained. For this reason the glass plates used below the lower lens were not placed nearer than six inches to the photoelectric cell. If a light beam still smaller in diameter is required in measuring very small areas, then a light source which produces less radiant energy can be used and the glass plates moved nearer to the photoelectric cell.

[1] R. B. Withrow, *Jour. Agr. Res.*, 50: 637–643, 1935.
[2] R. W. Gerdel and R. M. Saulter, *Jour. Amer. Soc. Agron.*, 20: 635–643, 1928.

TABLE 1
COMPARISON OF AREA READINGS USING EQUAL AREAS CUT FROM CARDBOARD AND LEAVES WHICH DIFFER IN COLOR AND THICKNESS

Leaf	No. of disks	Reading microamp.	Area cm²	Description of leaves
Cardboard ..	10	23.5	36.8	
Ficus	10	23.5	36.8	Thick, deep green
Coleus (yellow) ..	10	23.5	36.8	Thin, light green
Coleus (red)	10	23.4	36.1	Thin, red
Geranium ..	10	23.5	36.8	Thin, green
Codium	10	23.4	36.1	Thick, red
Pandanus ..	10	23.4	36.1	Thick, white
Ivy	10	23.4	36.1	Thin, green

Measurements were made to test the accuracy of results obtained by the method described by calculating the area of cardboard disks and comparing these areas and also those obtained through the use of a planimeter, with the areas of the disks as determined by the photoelectric method (Table 2). Measurements were made using cardboard disks of known areas and different colors and the results only varied about 1 per cent. from the mean. No significant differences in area readings resulted when the position of an object held between the glass plates was shifted, providing the object was kept completely within the boundary of the light beam. Finally the areas of attached leaves were measured, using the photoelectric method. These leaves were then removed from the plants and traced with a planimeter. Table 2 shows that leaf areas determined by means of the photoelectric method varied about 2 per cent., in the more extreme cases,

TABLE 2
COMPARISON OF RESULTS OBTAINED IN MEASURING THE AREA OF CARDBOARD DISKS AND LEAVES BY DIFFERENT METHODS

Object measured	No. of leaf or disk	Calculated area cm²	Area by photoelectric method cm²	Area by planimeter cm²
Cardboard disk ..	1	21.2	21.1	21.2
" ..	2	50.3	50.3	50.7
Coleus leaf (yellow)	3		23.4	23.2
"	4		22.4	22.2
"	5		20.9	20.4
"	6		20.9	20.5
Geranium leaf ..	7		49.2	48.7
"	8		50.0	50.5
"	9		35.6	35.3
"	10		41.2	40.8

from areas of the same leaves obtained with a planimeter.

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A SIMPLE QUARTZ MERCURY ARC

THE small and inexpensive arc to be described has proved to be exceedingly useful for many laboratory purposes. It can be used conveniently with a monochromator or filters to obtain fairly intense visible and ultra-violet monochromatic radiations. In our laboratory it has been used for the following purposes: (1) In conjunction with a quartz monochromator and quartz microscope to make photomicrographs with visible and ultra-violet monochromatic radiation and to study the effects of these radiations on micro organisms.[1] (2) In conjunction with a microscope to make cinema films of micro organisms. (3) For dark field photomicrographs. (4) As a source of ultra-violet radiation for fluorescence microscopy. (5) With filters as a monochromatic light source for the polariscope. (6) As a light source for studying Raman spectra.

The arc can be made in practically any shape to meet specific experimental requirements. Two types which will satisfy most requirements, one having a vertical and one having a horizontal discharge tube, will be described.

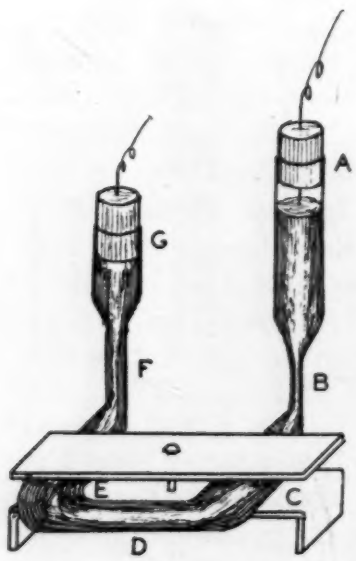

FIG. 1a.

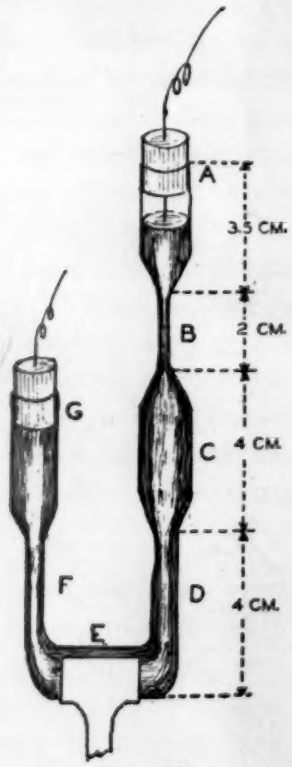

FIG. 1b.

Following are instructions for constructing the arc (see Fig. 1 (a) and (b)): A clear fused quartz tube 25 cm long with an approximate bore of 8 mm is pulled down to about 0.5 mm bore at B. This is done to prevent the arc from oscillating. The tube is then pulled down to 3–4 mm at D, which is the part in which the arc is maintained. The tube is also pulled down at F to a 1–2 mm bore. This constriction serves to diminish the heat conduction to G. The tube is then bent into the desired form; the horizontal type is shown in Fig. 1 (a) and the vertical type in Fig. 1 (b). The tube is then filled with very clean mercury and heated until all air bubbles are expelled by boiling. A tight-fitting cork stopper containing an iron electrode is inserted into G. A small flat head stove bolt serves admirably, for the nut can be turned up so as to expand the cork, causing a tight fit when the cork has been inserted into the tube. A loose-fitting stopper is inserted at A so as to allow air to escape when the mercury column is heated. The arc is operated from a 110 V. D.C. circuit in series with a 1.5 ampere 100 ohm variable resistance (a 150 watt lamp will often suffice). The arc is started by heating at D with the flame of a Bunsen burner until the mercury is separated by the vapor pressure of the mercury. When the arc is struck, about one ampere flows through the circuit. An inductance placed in series often improves the operation of the lamp. The portions C and E are made larger to provide more cooling surface. Part C of the vertical lamp tends to become too hot, causing the arc to migrate from D to C and it is sometimes necessary to wind copper wire about this part to cool it adequately. In the horizontal type a holder, made of $\frac{1}{8}$″ lead sheet, as indicated in Fig. 1 (a), provides adequate cooling surface to stabilize the arc. Lead is used on account of its flexibility and weight. For use with the microscope, the holder can be made so as to facilitate placing the arc just under the condenser and thus eliminate the use of a mirror. A fan can be used to prevent excess heating of the microscope.

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